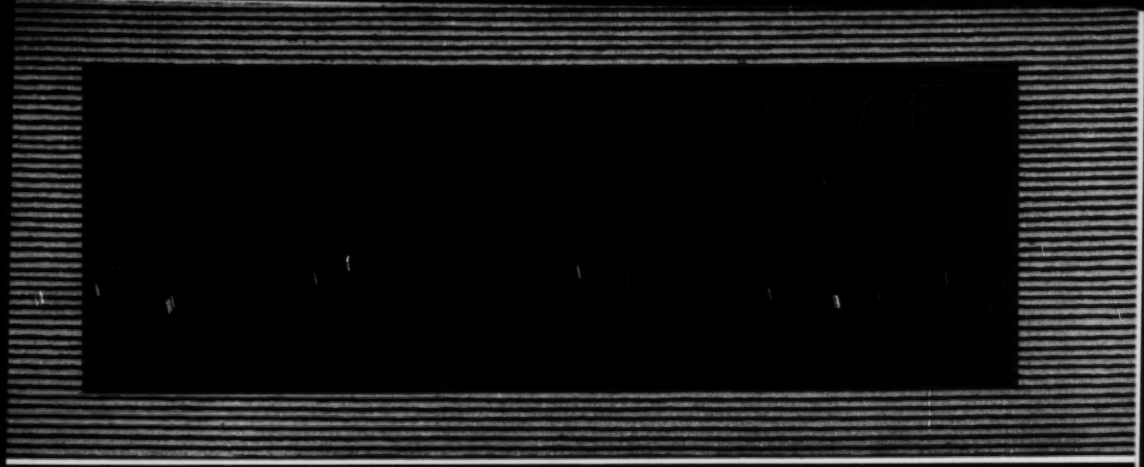

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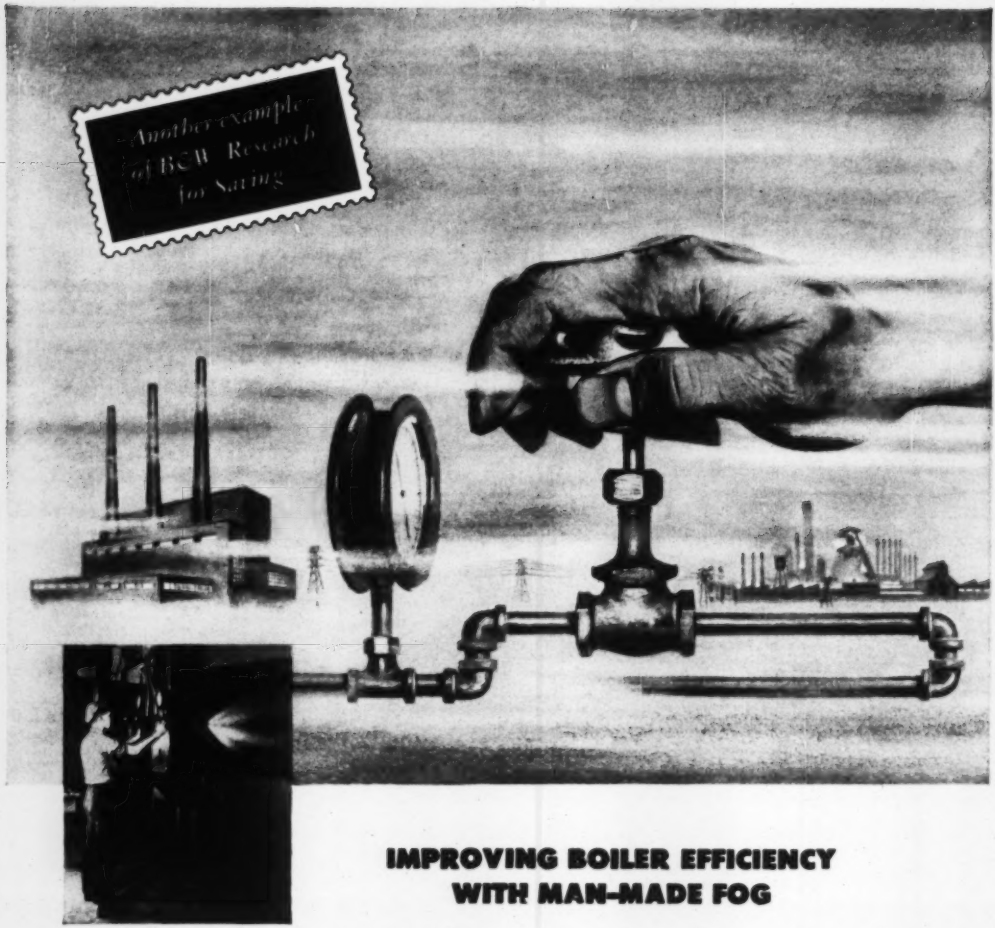

IMPROVING BOILER EFFICIENCY WITH MAN-MADE FOG

The importance of fuel research is illustrated by the fact that most boilers burn fuel in an amount equal to, or as much as twice the value of, the original boiler investment—*every year*. That's why B&W research has long concerned itself with curbing the voracious appetite of boilers, large and small.

For example, B&W has pioneered a method of quantitative measurement of oil-burner sprayer-plate patterns. In this method, water rather than oil spray, is the test medium used to determine number and arrangement of atomized particles impinging upon a standard grid surface during fixed period of exposure.

Here again, resourceful engineering was applied to a previous, relatively inaccurate, qualitative test method to insure higher degrees of *predictable* efficiency in finished jobs.

B&W fuel-research—whether applied to oil, coal, gas, wastes, or any of the many alternative methods of firing these fuels—continually is adding to the knowledge of fuel-burning from which so many of the significant advancements in steam generating economies have been derived. The Babcock & Wilcox Company, 85 Liberty St., New York 6, N. Y.

Helping Industry Cut Steam Costs Since 1882—through Research, Engineering, Equipment, Erection and Maintenance Services.

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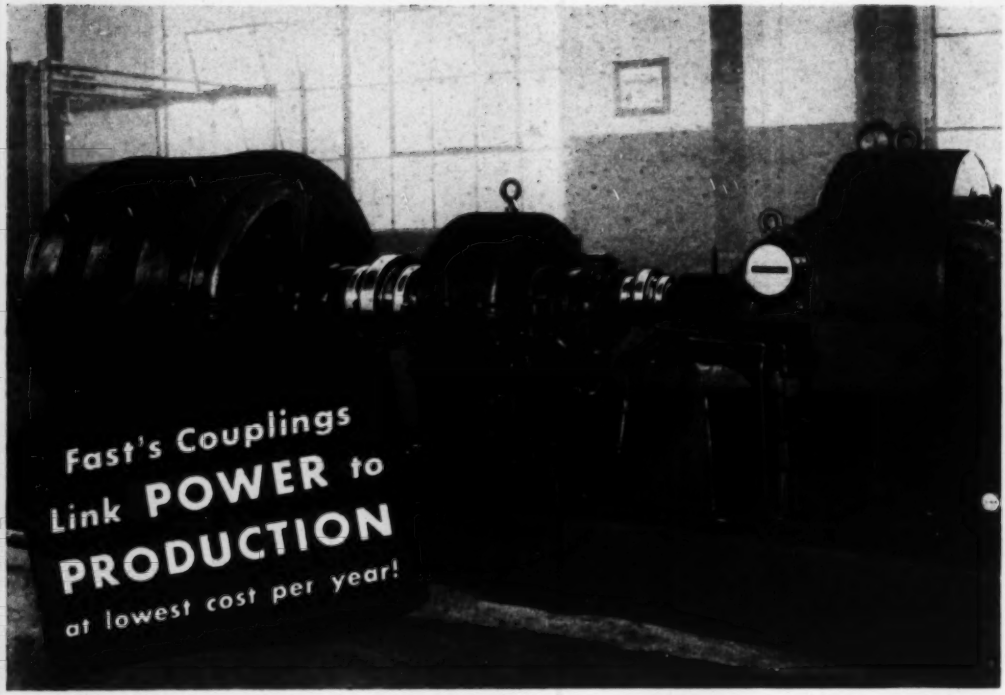

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HIGH-SPEED equipment demands components with superior strength, accurate manufacture, long-lasting dependability. That's why it's important to *you* that Fast's Couplings are selected by every major high-speed equipment producer!

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Not just another specialized dual-beam oscillograph, but a brand-new type designed for general development work but rugged enough for production testing and industrial applications as well. Compactness, lightweight, ruggedness and versatility mark the Du Mont Type 322 as another milestone in cathode-ray oscillography.

FEATURES **All the well-known features of the 304-H, and...**

Thoroughly field-tested.

Individual and common time bases with driven or recurrent sweeps and sweep expansion on all sweeps.

Conventional single-ended input with stepped and vernier attenuators, or balanced input with no attenuation, on both Y-axes.

Concentric controls for easy-to-operate, compact control panel.

High-gain D-C amplifiers on both channels.

Amplitude calibration on either channel on both axes.

Illuminated scale with dimmer control.

SPECIFICATIONS

Cathode-ray Tube — Type 5SP — Dual-beam Cathode-ray Tube. Accelerating potential, 3000 volts.

Y-Deflection Sensitivity — 0.028 peak-to-peak (0.01 rms) volts/inch from D-C to 300 KC (50% down at 300 KC); A-C coupling, 10% down at 5 c.p.s.

X-Deflection Sensitivity — 0.3 peak-to-peak (0.1 rms) volts/inch from D-C to 300 KC (down 50% at 300 KC); A-C coupling down 10% at 5 c.p.s.; common, D-C to 200 KC (down 50% at 200 KC).

Linear Time Base — Recurrent and driven sweeps variable in frequency from 2 to 30,000 c.p.s. Front panel connections provided for lower frequency by adding external capacitance.

Intensity Modulation — Input impedance 0.2 megohm, paralleled by 80 $\mu\mu$f. Negative signal of 15 volts peak blanks beam at normal intensity settings.

Beam Control Switch — On front panel to turn beams on or off independently or simultaneously.

Calibrator — Regulated potentials of 50 millivolts and 1 volt peak-to-peak squarewave at power line frequency available at front panel binding posts.

Power Source — 115/230 volts — 50-400 c.p.s. — 225 watts.

Dimensions — Height 15¾", width 12½", depth 22⅞", weight 75 lbs.

$835.00

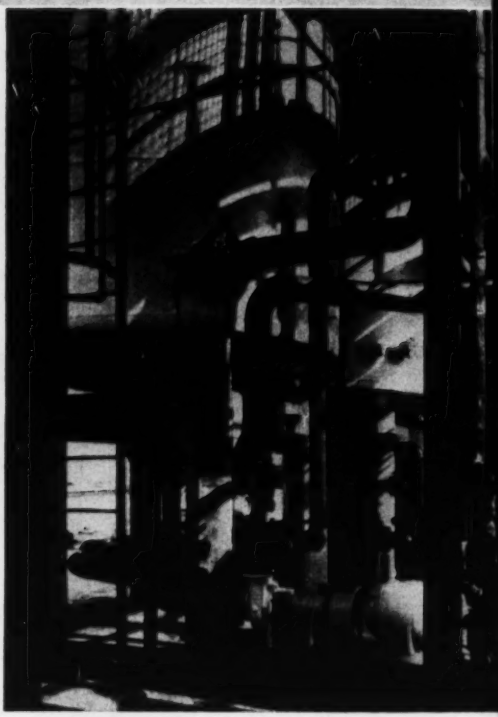
Write for complete technical details:

Instrument Division
Allen B. Du Mont Laboratories, Inc.
1500 Main Avenue, Clifton, N. J.

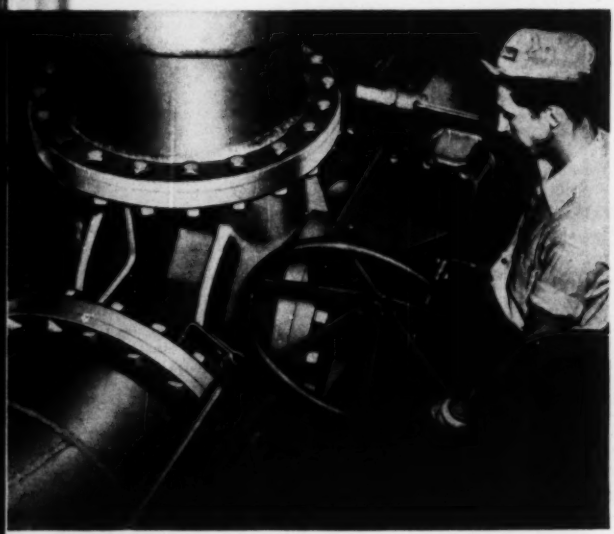
Nordstrom Valves Prove Suitability

EXAMPLES: *Chloromycetin, Ethylene Cyanohydrin, Brine, Calcium*

VARNISH—After processing each batch of varnish, a California paint manufacturer pumps varnish base through this manifold of Nordstrom three-way, three-port valves. One operator can divert varnish to six thin-down and blending tanks. Vapor-tight, lubricant-sealed Nordstrom valves turn easily even in lines carrying varnish of high viscosity.



ETHYLENE CYANOHYDRIN—A base in the manufacture of acrylates used in such products as coatings for leather, textile finishes and adhesives, ethylene cyanohydrin is in turn manufactured in Nordstrom-equipped unit at Texas plastics plant near Houston. Gear, wrench and chain operated Nordstrom valves simplify opening and closing of suction and discharge lines.

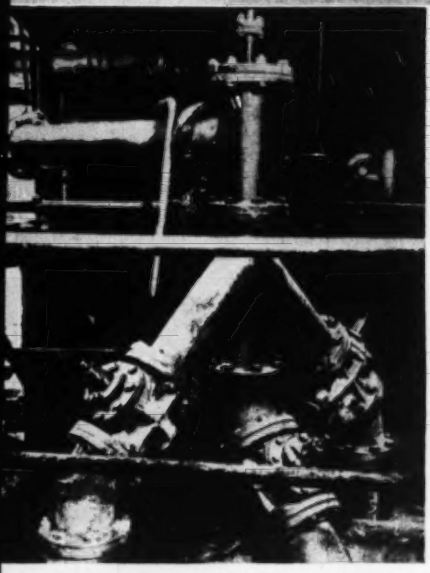


BRINE—At Trona, Calif., in a desert chemical plant, 24-inch four-way Nordstrom valves like these are used for flow line reversal. Through them, brine is pumped from Searles Lake to plant to be converted into potash, soda ash, borax, salt cake and other products. Ordinarily, four straightway valves would be required in place of each of the Nordstrom four-way valves. Flow is reversed merely by rotating valve plug 45 degrees.

CHLORINE—Niagara Falls, N.Y. chemical plant, produces chlorine in wet gas form, then dries it and compresses it to a liquid for use in industry. Nordstrom valves on pump and process lines control the chlorine prior to liquefying.

for Tough Chemical Services

Hypochlorite, Varnish, Chlorine, Ethylene and Propylene Glycol



CALCIUM HYPOCHLORITE—A basic ingredient in the manufacture of book matches, calcium hypochlorite bleach liquor is handled by these Nordstrom valves in upstate New York plant of big match maker. Other Nordstrom controlled lines in the plant carry lime slurry and chlorine.

In the process industries, in some of the most erosive and corrosive services to which valves are subjected, there are thousands of successful, trouble-free Nordstrom valve installations. Those shown here are typical.

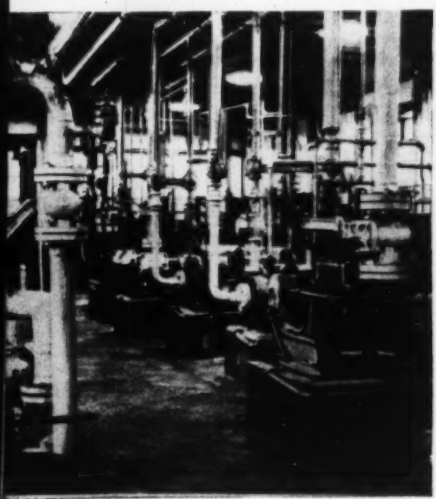
Nordstrom valves, with the extra seal and protection of lubricated seating surfaces and the hydraulic jacking action that keeps the plug in free working condition, are made in a whole series of patterns and metals especially for the process industries.

For example, Nordstroms can be had for not only straightway flow but in a variety of three-way and four-way designs as well, ideal for piping arrangements calling for switching flow from line to line.

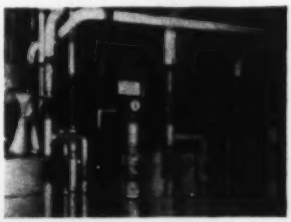
Among the metals in which Nordstroms are built are Type 316 Stainless Steel, Nickel, Monel, Type No. 2 Ni-Resist, Nordco Bronze, Hastelloy B, and Mercoloy, all chosen for special resistance to various chemicals.

If you specify valves or meters for process lines you should have a copy of the new Bulletin, "*Nordstrom Valves and Rockwell Meters for the Process Industries.*"

Write Today for Free Process Industries Bulletin



PROPYLENE GLYCOL—Glycols, being hard to freeze and slow to boil, find use in anti-freezes and coolants and are also softening agents for textiles, cellophane, tobacco, glue, cork and paper. In processing glycols, Nordstrom valves are widely used by Michigan chemical plant. In the cold pump room above, for example, Nordstroms regulate flow of ethylene and propylene glycol.



CHLOROMYCETIN—This 5000 gallon Nordstrom valve-controlled fermenter in laboratories of Detroit pharmaceutical manufacturer is a key step in processing of the wonder drug, Chloromycetin. Several hundred Nordstroms in sizes from ¾ to 20 inches, straightway and Multiport types, in stainless and semi-steel and type No. 2 Ni-Resist are used in the process lines of this company's antibiotic division.

Typical Applications of Nordstrom Valves in the Process Industries

- Beverage Plants
- Cement Plants
- Chemical Plants
- Explosive Manufacturing
- Food Plants
- Gas Pipe Lines
- Ice and Refrigeration
- Oil Well Drilling
- Paint and Lacquer Mills
- Paper and Pulp Mills
- Petroleum Refineries
- Pharmaceutical Plants
- Power and Steam Plants
- Rubber Mills
- Sewage Plants
- Smelters and Mines
- Soap Factories
- Steel Mills
- Sugar Refineries
- Synthetic Ammonia Plants
- Synthetic Fibre Plants
- Synthetic Plastic Plants
- Synthetic Rubber Plants
- Tanneries
- Textile and Dye Plants
- Water Works

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Nordstrom Valves

Lubricant Sealed to Keep Upkeep Down

Another Rockwell *Product*

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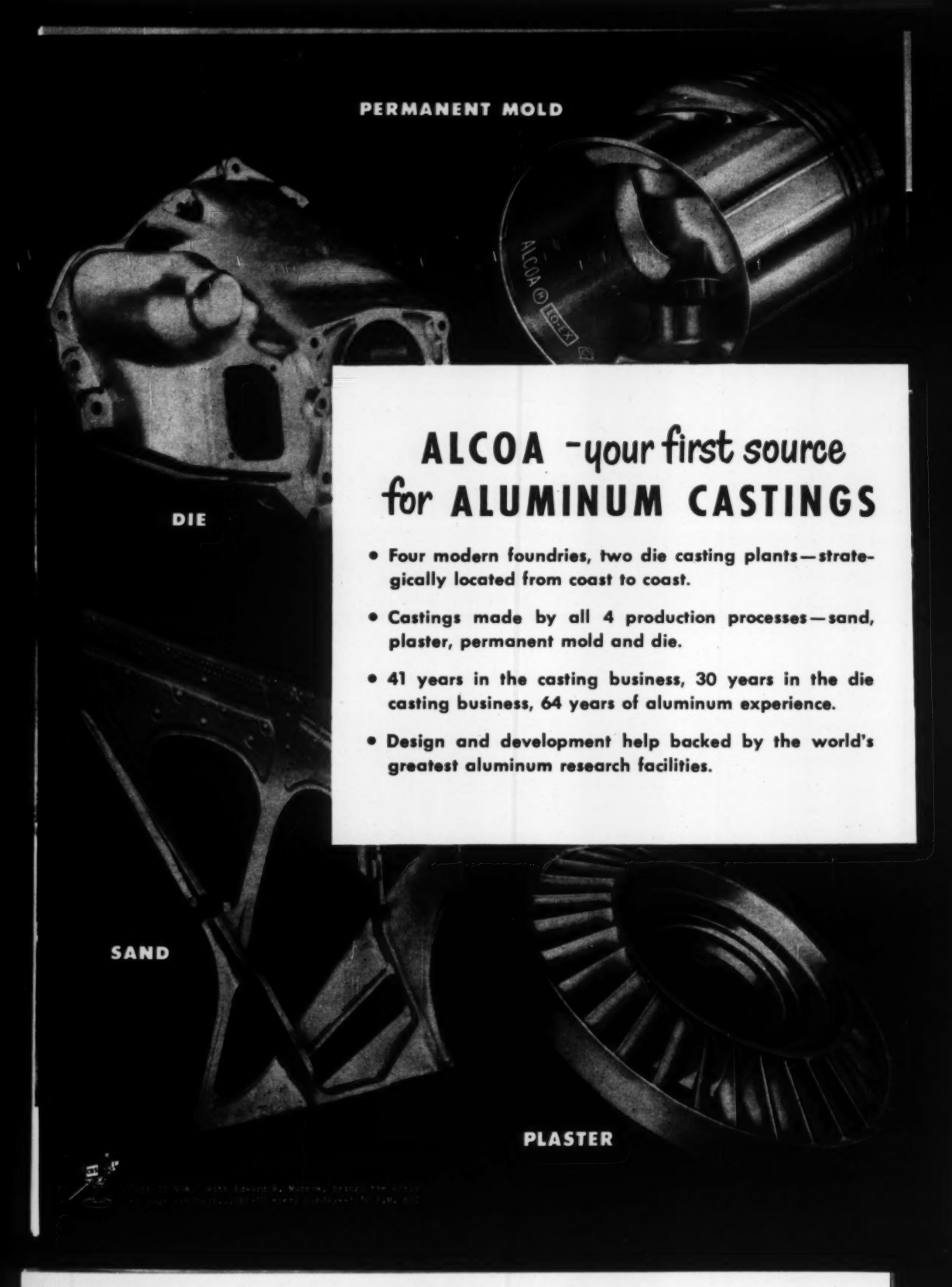

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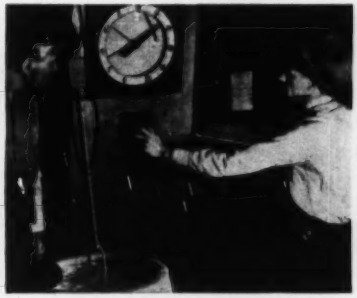
- Four modern foundries, two die casting plants—strategically located from coast to coast.
- Castings made by all 4 production processes—sand, plaster, permanent mold and die.
- 41 years in the casting business, 30 years in the die casting business, 64 years of aluminum experience.
- Design and development help backed by the world's greatest aluminum research facilities.

Facilities like these mean satisfaction with your source of supply—

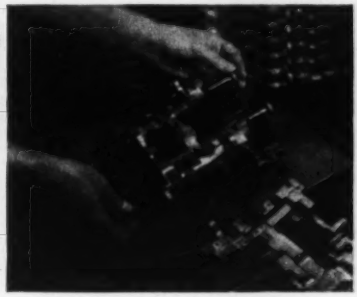
CORE MAKING—fast, high quality production of cores is assured by Alcoa's modern sand handling equipment and large capacity core ovens.



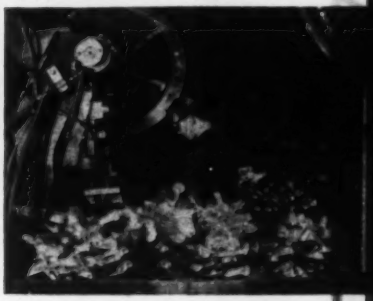
POURING TEMPERATURES—are constantly checked and recorded at control stations on all foundry floors. Procedure like this and continuous alloy control guarantee highest quality aluminum castings and die castings.

HIGH PRODUCTION CAPACITY—of Alcoa's die casting plants is partially represented in this row of cold chamber machines at Alcoa's Chicago die casting plant.

PERMANENT MOLD CASTING—formerly considered for small parts only. Today permanent mold castings weighing up to 500 pounds are not unusual.



INSPECTION—of every part is standard practice in Alcoa plants. Dimensional checks, as shown here, or visual inspection by trained personnel reduces costly rejects. Metallurgical checks further guard the castings' quality.



FINISHING—many secondary machining operations are performed by Alcoa foundries and die casting plants. Machining, grinding, sand blasting, and ball burnishing are but a few.

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While the sale of our products is presently controlled by government regulations, you'll find no limitations on help in design, application or fabrication. Your local Alcoa sales engineer and your local Alcoa distributor are headquarters for "everything" in aluminum. They will cooperate to the fullest in helping you get the metal you need. They are listed under "aluminum" in your classified phone book.

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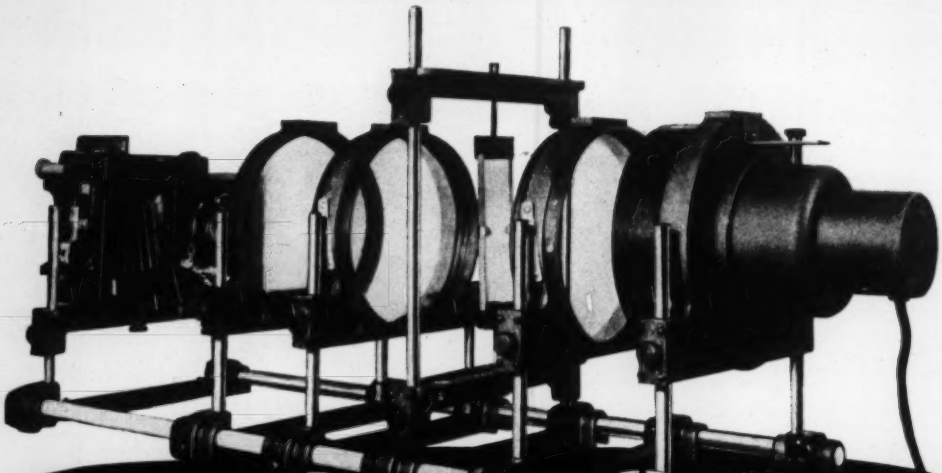

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The recently announced G R Type 1534-A Polariscope takes the study of stress analysis out of the laboratory and right into the design office, the drafting room and the demonstration room.

For the study of static and dynamic stresses in transparent photoelastic models, this polariscope opens up many new possibilities in the design of structural members and in the demonstration of stress analysis.

The Type 1534-A Polariscope consists of an assembly of light rods, supports and disc mounts weighing only 32 pounds! The analyzer and polarizer are sheets of Polaroid film which allow the unusually large optical field of eight inches.

A 100-watt incandescent lamp is used for visual observations; the accessory Type 1532-B Strobolume permits excellent photographs to be taken at 40 microseconds (1/25,000 sec.) with any long-bellows camera having a lens as fast as f 4.5.

The quarter plates and analyzer polarizer plates are easily removed. The instrument is very convenient to use, being simpler than an optical bench. It is only 36 inches long, 14 inches wide and 16½ inches high, and permits horizontal and vertical adjustments over wide ranges.

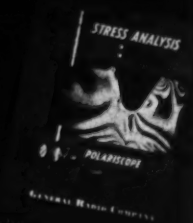
Type 1532-B Strobolume

Type 1534-A Polariscope

$490.00

Type 1532-B Strobolume

$265.00



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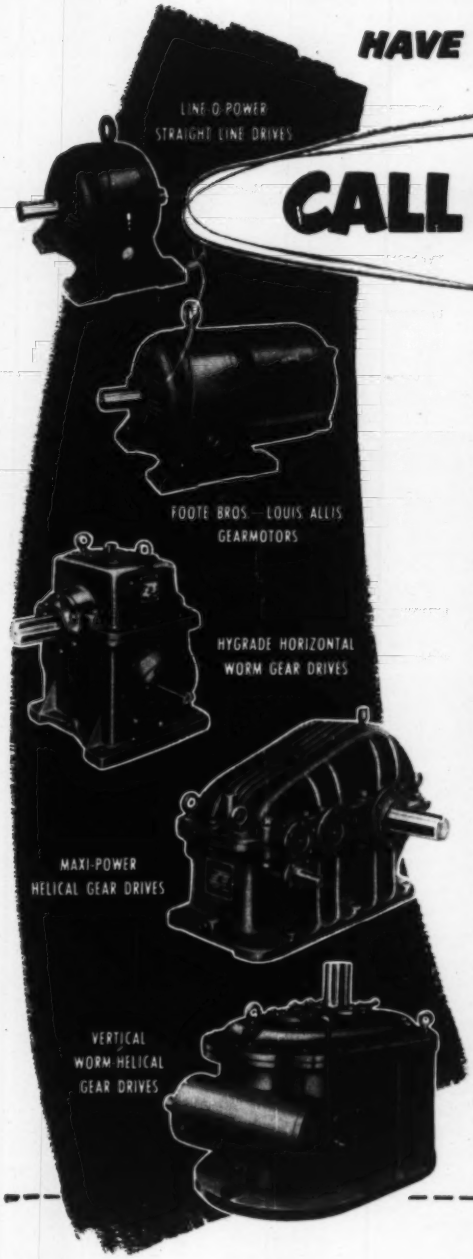

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Heavy duty drives with precision worm gearing that assures high efficiency and load-carrying capacity. Horizontal, vertical and Hytop (extended shaft) types. Ratios from 4⅛ to 1 up to 4,108 to 1. Capacity up to 260 horsepower.

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Heavy-duty helical gear drives. Available in single reduction units, ratios up to 9.91 to 1; capacities up to 1,550 horsepower; double-reduction units, ratios from 9.32 up to 71 to 1, capacities to 1100 horsepower; triple reduction units, ratios from 79 up to 360 to 1, capacities up to 420 horsepower.

WORM-HELICAL GEAR DRIVES
Heavy duty vertical drives with horizontal input shafts and vertical output shafts—up or down. Ratios from approximately 25 to 285 to 1 and a capacity range up to 128 horsepower.

Foote Bros. Gear and Machine Corporation
Dept. Q, 4545 South Western Boulevard
Chicago 9, Illinois

- ☐ Bulletin HGA Hygrade Worm Gear Drives
- ☐ Bulletin LPB Line-O-Power Straight Line Drives
- ☐ Bulletin MPB Maxi-Power Helical Gear Drives
- ☐ Bulletin GMA Foote Bros.-Louis Allis Gearmotors
- ☐ Bulletin WHA Worm-Helical Gear Drives

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City..... *Zone*..... *State*.....

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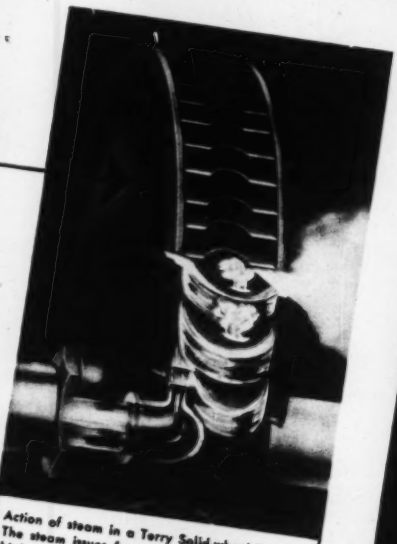
TERRY

THIS TURBINE WHEEL

has no parts to loosen or work out

The rotor of the Terry Solid-wheel Turbine is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to become loose or work out.

The power-producing action of the steam takes place on the curved surfaces at the back of the buckets. Hence, wear of the blades is of little consequence, as it does not materially affect horsepower or efficiency. There is practically no end thrust since the steam enters and leaves the wheel in a direction at right angles to shaft.



Action of steam in a Terry Solid-wheel Turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket where its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.

This is only a small part of the story of the many advantages of the Terry Solid-wheel Turbine. Write for complete details.

THE TERRY STEAM TURBINE CO.

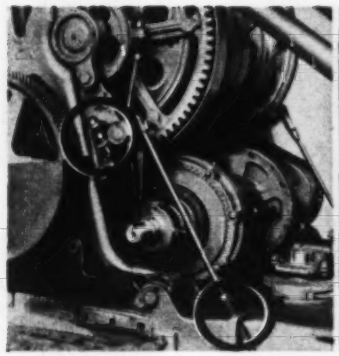
TERRY SQUARE, HARTFORD 1, CONN.

77-1189

Memo

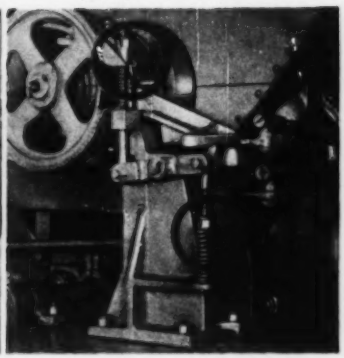
Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.

For a nut that won't vibrate out of adjustment



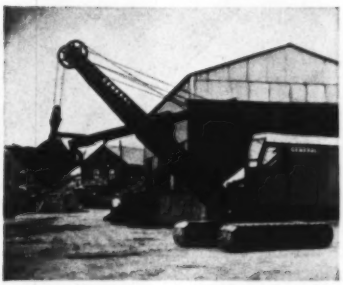
LOCKS ANYWHERE . . . Spring-loaded reach-rod and stop lever on this new General Excavator shovel depend on Elastic Stop Nut's positive gripping action. The elastic collar permanently positions the nut anywhere on the bolt to accurately maintain spring-loaded settings.

VIBRATION-PROOF . . . Idler tumbler on this new shovel must maintain constant tension against crawler belt. An Elastic Stop Nut holds it firm in the face of vibration and heavy impact loads. The Famous Red Elastic Collar hugs threads, damps out vibration.



EASILY ADJUSTED . . . On applications like these, General Excavator has provided its customers with the easy, sure method of adjustment—Elastic Stop Nuts. These nuts take hair-fine adjustment in the field or in the factory—and hold it indefinitely.

use Elastic Stop nuts



This newest earth mover of the General Excavator Company is 100% equipped with Elastic Stop Nuts. At 750 key spots General Excavator simplified assembly with these standard fasteners—offers customers less maintenance, easier maintenance.

Elastic Stop Nuts are supplied with integral locking collars of nylon or fiber—permit multiple reuse—have military, naval, and air force approvals. For design information on Elastic Stop Nuts, contact your local ESNA representative, or mail the handy coupon to Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union, N. J.

Elastic Stop Nut Corporation of America is also maker of the ROLLPIN

ROLLPIN TRADEMARK

Dept. N3-211, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, N. J.

Please send me the following free information on ESNA self-locking fasteners:

- ☐ AN-ESNA conversion chart
- ☐ Elastic Stop Nut Bulletin
- ☐ Rollpin bulletin and sample Rollpins
- ☐ Here is a drawing of our product. What self-locking fastener would you suggest?

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Firm _____

Street _____

City _____ Zone _____ State _____

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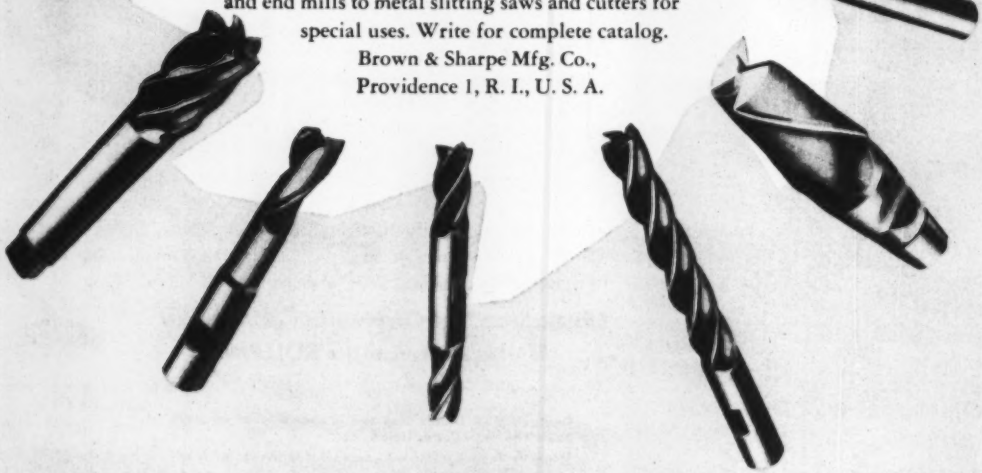
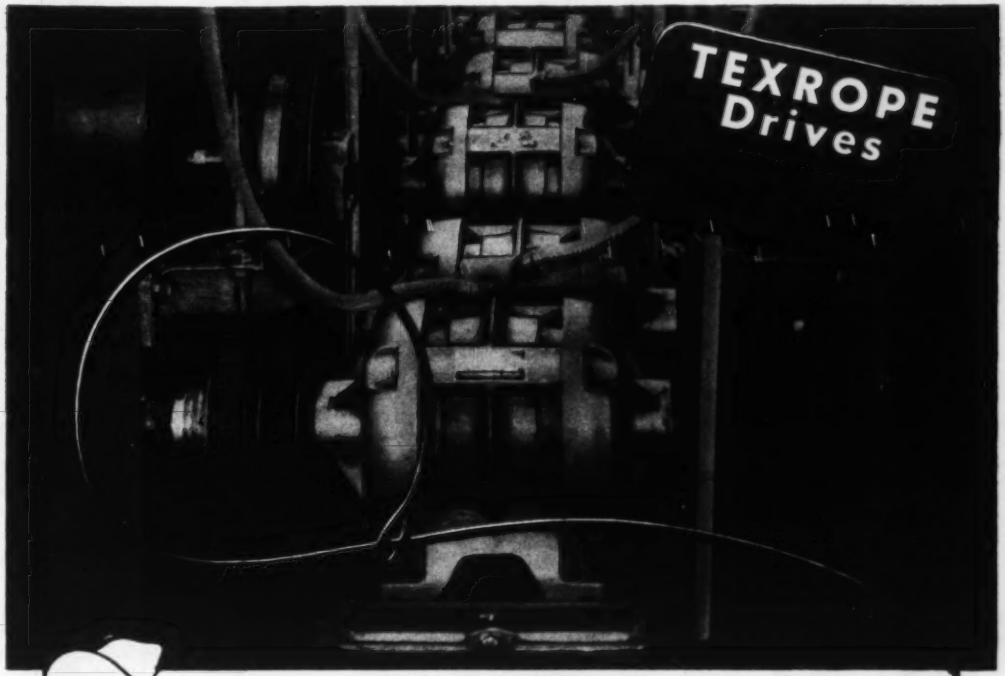
Styles include every type from plain milling cutters and end mills to metal slitting saws and cutters for special uses. Write for complete catalog.
Brown & Sharpe Mfg. Co.,
Providence 1, R. I., U. S. A.



WE URGE BUYING THROUGH THE DISTRIBUTOR

Brown & Sharpe B·S



TEX SAYS: Speed Control Can Cost So Little USING VARI-PITCH DRIVES

ASK ABOUT *Vari-Pitch* drives! Whether you want to change speeds while your machine is in motion or stopped, there's a low cost *Vari-Pitch* drive for the job.

You'll find a *Vari-Pitch* sheave used with a standard motor can often give the same smooth, stepless speed control as a multi-speed motor or expensive control costing many times more.

For example, many textile mills are using *Vari-Pitch* sheaves to make the delicate speed adjustments they require when yarns are changed. This means mills can achieve a degree of modernization with this one low-cost changeover. Other industries are enjoying similar benefits.

It's especially low cost when you remember old motors need not be replaced by special motors or control. To get variable speed with *Vari-Pitch* drives, only the sheaves need be changed. Take a tip from these mill operators. Check into *Vari-Pitch* drives.

GO TO V-BELT DRIVE HEADQUARTERS— Allis-Chalmers has the widest range of variable speed drives in the industry. Moreover, you can be sure your job is figured right if you get your drive from Allis-Chalmers, for more industrial V-belt drives have been engineered by A-C than by any other company.

Call your nearby Allis-Chalmers distributor or district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3589

Texrope and Vari-Pitch are Allis-Chalmers trademarks.

Choose from These Types of Variable Speed Drives

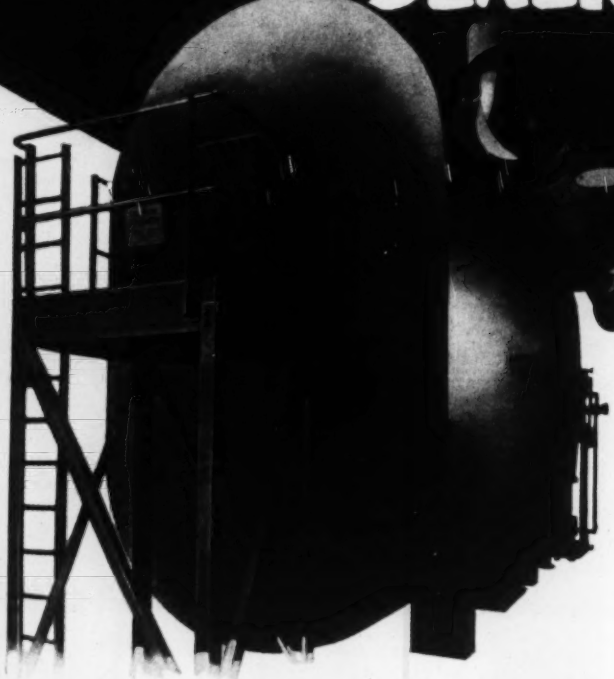
VARI-PITCH SHEAVES for A-B, B, C, D, and E belts — speed variation 15% to 25% per sheave. Capacities 1 to 125 hp. Stationary type — for changing speed when motor is stopped. Motion Control type — for changing speed when motor is running.

WIDE RANGE VARI-PITCH SHEAVES for Q or R wide belts provide up to 2 to 1 speed range . . . fractional to 40 hp. Available in Stationary Control and Automatic types.

VARI-PITCH SPEED CHANGER — enclosed unit for adjusting speed while machine is in motion. Provides up to 3.75 to 1 speed range. Capacities 1 to 75 hp.

ALLIS-CHALMERS

COCHRANE MULTI-STAGE DEAERATOR



Below is shown one of two Cochrane Multi-Stage Deaerators — capacity 40,000 lb./hr., handling 100% make-up at a prominent public utility station.

At the left is shown a Cochrane Multi-Stage Deaerator, of elliptical design, installed in one of the country's most important electric generating stations. With a capacity of one million pounds per hour, it deaerates returned condensate to zero oxygen (0.005 cc. per liter) before being fed to the high pressure boilers.

COCHRANE originated and for many years has supplied the MULTI-STAGE DEAERATOR for the complete deaeration of 100% cold saturated water and for turbine condensate or other supplies where the difference in water inlet and outlet temperatures may be as small as 20° or 30° F. It is designed as two heaters in series. The top heater is of the jet type and the lower heater of the down-flow tray type. In the jet heater, the water is heated to within a few degrees of steam temperature and the bulk of the non-condensable gases are liberated. The water, with very low oxygen content, passes down to the tray heater where complete heating and deaeration takes place. The first heater acts as a direct contact vent condenser for the second heater, permitting omission of the vent condenser.

Write for a copy of Publication 3005.

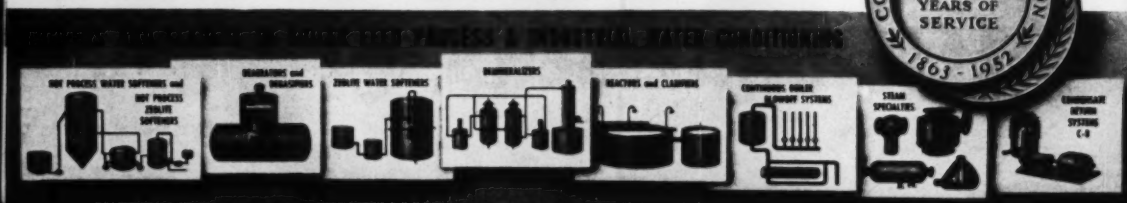
COCHRANE CORPORATION, 3142 N. 17th St., PHILADELPHIA 32, PA.

In Canada: Canadian General Electric Co., Ltd., Toronto • In Mexico: Babcock & Wilcox de Mexico, S. A., Mexico City

In Europe: Recuperation Thermique & Epuration, Paris

COCHRANE

COCHRANE CORPORATION 89 YEARS OF SERVICE 1863 - 1952



No stuffing box troubles in

HAGAN RING BALANCE METERS

because there are no stuffing boxes!

Forget about stuffing box troubles and pressure tight bearings when you install Hagan Ring Balance Meters. The simple, flexible S-tube connections to the ring assure dependable accuracy and trouble-free operation.

Features of the Hagan Ring Balance Meter include:

- **Calibration Can be checked under operating conditions by check-weight method**
- **Excellent response at extremely low flow rates**
- **Mercury level not critical**
- **Full-scale chart differential is adjustable over a 7-to-1 range**

HAGAN CORPORATION

HAGAN BUILDING
PITTSBURGH 30, PENNSYLVANIA

Our engineers will be glad to show you how Hagan Ring Balance Meters can help solve your metering problems. Use the coupon, or write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

Hagan Corporation
Hagan Building • Pittsburgh 30, Pennsylvania

Please send me further information on Hagan Ring Balance Meters. I am particularly interested in .....

.....

NAME .....

POSITION .....

COMPANY .....

STREET AND NUMBER .....

CITY ..... ZONE ..... STATE .....

ME-2

Now a new name

to start our second half century . . .

CHICAGO METAL HOSE CORPORATION

Flexonics *Corporation*

Sales operations are divided into four logical divisions

CHICAGO METAL HOSE DIVISION

Corrugated and convoluted flexible metal hose, machine tool conduit, refrigeration conduit, "Vibra-Sorber" vibration eliminators for piping, and assemblies for specific applications.

AIRCRAFT DIVISION

Stainless steel aircraft components including hose of all types, bellows, oil and fuel lines, air lines, ducting and connectors of all types and many special assemblies for jet aircraft.

FLEXON BELLOWS DIVISION

Stainless steel bellows, brass and bronze bellows, automobile thermostats and bellows and bellows assemblies and devices for all types of standard and specialized applications.

EXPANSION JOINT DIVISION

Standard corrugated packless type expansion joints in free-flexing and controlled-flexing construction, high pressure Flexoniflex expansion joints, heat riser expansion joints, and special joints.

• In 1947, Chicago Metal Hose Corporation introduced to industry a new science—the science of Flexonics. It is defined as the controlled bending of thin metals for use under varying conditions of temperature, pressure, vibration and corrosion. This definition so well describes our operations and the expanding range of our products that we are adopting it as our corporate name coincident with our 50th anniversary year.

Let us assure you, however, that the change from Chicago Metal Hose Corporation to Flexonics Corporation involves no change in management, personnel or methods of operation except for internal organizational changes that will make it possible for a fast growing company to serve its customers better.

Flexonics *Corporation* **1305 S. THIRD AVENUE · MAYWOOD, ILLINOIS**

FORMERLY CHICAGO METAL HOSE CORPORATION

Flexon identifies CMH products that have served industry for over 50 years.

Manufacturers of Convoluted and Corrugated Flexible Metal Hose in a Variety of Metals · Expansion Joints for Piping Systems · Stainless Steel and Brass Bellows · Flexible Metal Conduit and Armor · Assemblies of These Components

In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

IT ALWAYS PAYS TO SPECIFY

LADISH

Controlled Quality

PIPE FITTINGS

L

TO MARK PROGRESS

...where flow efficiency is a vital factor

You can depend on Ladish Controlled Quality Fittings to maintain maximum flow characteristics of any piping system . . . and do it consistently year after year. For advanced Ladish engineering assures the true circularity, full effective radii and smooth inner surfaces necessary to keep turbulence and friction loss at a minimum . . . features which are doubly safeguarded by the high, inflexible standards of Ladish Controlled Quality.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
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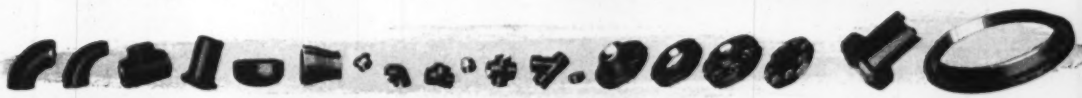
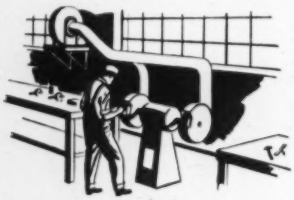


American Blower... a time-honored name in air handling

Charleston, W. Va., has a conveniently located American Blower Branch Office to provide you with data and equipment for air handling. You can reach American Blower in Charleston by calling 61-331. In other cities consult your phone book.

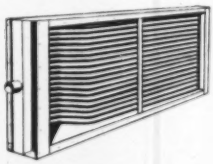
EMPLOYEE COMFORT

Fresh, invigorating air, indoors, does much to increase employee morale and efficiency. American Blower Ventura Fans are ideal for the job. They're attractively streamlined propeller fans with smooth-flowing lines that harmonize well with modern business interiors. Wiring is fully enclosed for safety. A square mounting panel makes them easy to install. All Ventura Fans are sound-rated and capacities are Certified.



ABRASIVE MATERIALS

If you've found dust from grinding machine operations hard to handle, American Blower Type V Fans are well worth investigating. The heavy cast-iron housing of Type V fans easily withstands the wear of hard, gritty, abrasive materials. Also, their volume and pressure range is more than adequate to handle the normal requirements of this type of work. Remember, good ventilation is good business.

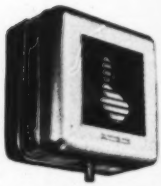


HEATING COILS

Current demands for heating from business and industry are greater now than ever before – a good reason to take early action on American Blower Heating Coils. Whether you need coils for use in blast heating or zone reheating – you'll find the size and type to fit your needs in the American Blower line. All tubing is helically wound with copper or aluminum fins in 3 standard spacings. Casings are heavy galvanized steel; headers are die-formed steel.

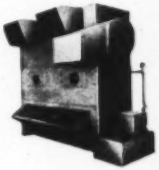
YOUR BUSINESS

Whatever your needs, American Blower heating, cooling, drying, air conditioning and air handling equipment will improve over-all comfort and efficiency in your business. For data, phone or write our nearest branch office.

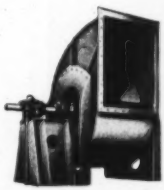


Unit Heaters

Ventura Fans



Air Conditioning Equipment



Industrial Fans

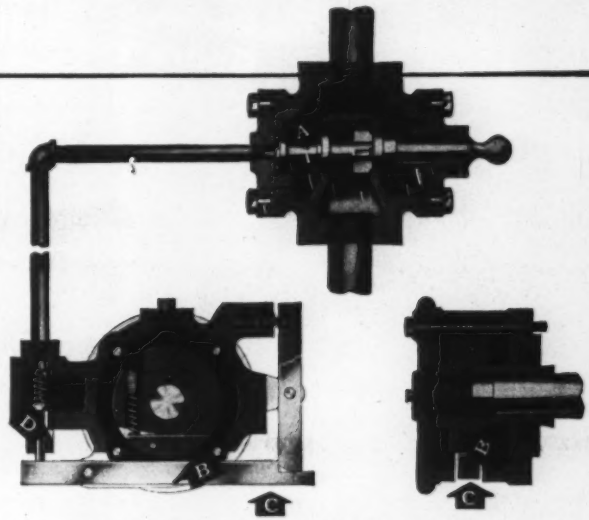
Utility Sets

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

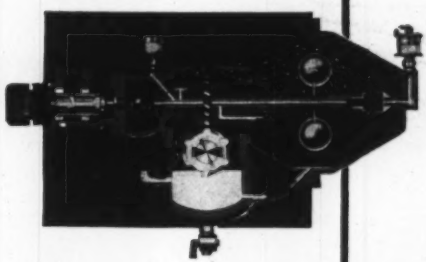
YOUR BEST BUY AMERICAN BLOWER AIR HANDLING EQUIPMENT

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • ACME CABINETS • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

Only Coppus Turbines offer you *a pilot operated* excess speed safety trip



The constant speed governor on Coppus Turbines, plus this Excess Speed Safety Trip, gives you extra protection for your turbine investments. Here's how it works. When steam is turned on, pressure opens valve A fully. When excess speed is reached, centrifugal force throws weight B against lever C lifting pilot valve D. This releases pressure in back of valve A, closing this valve instantaneously, to shut off the steam. Safety trip can be tested easily while turbine is running by manually tripping and resetting lever C.



Sectional view showing lubricating system of fully enclosed Coppus Constant Speed Governor. Governor head acts directly on stem of steam admission valve. No external levers required. Ball bearing construction eliminates end play and gives frictionless operation.

Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes

CUT YOUR COSTS PER HORSEPOWER

When you choose from the Coppus Steam Turbine line, you get the right size for your requirements . . . and make substantial savings on *any* size from the 150 hp turbine down to the smallest. Low in first cost, Coppus Turbines save you more money in the long run. Operating and maintenance costs are kept low by such other features as: large number of steam nozzles, controlled individually by manually operated valves; hard chromium plating on shaft at the stuffing box; replaceable cartridge type bearing housings; optional carbon ring packing assembly for back pressures up to 75 pounds.

WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORPORATION, 362 Park Ave., Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES

Gears you will always remember
. . . service you will never forget!

YOU will always remember the *quality* of Illinois gears, the fact that they meet specifications, that the finish and accuracy is right, that they are dependable.

You will never forget the service you get from Illinois Gear & Machine Company — on-time, as-promised deliveries — extra speed when you are in a tight spot — prompt attention to your requests and problems.

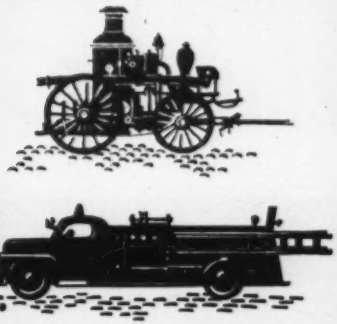
Write, wire or phone today:

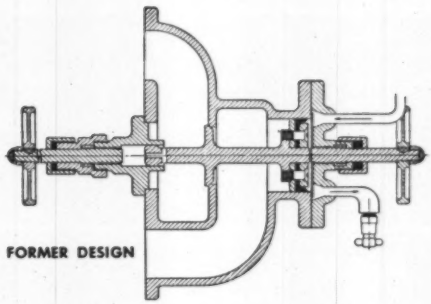
Gears for Every Purpose

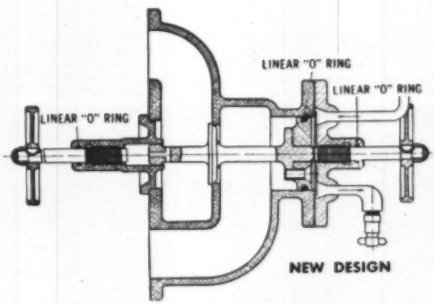
ILLINOIS GEAR & MACHINE COMPANY

[illegible] N. WATCHES AVE. • CHICAGO 35, ILLINOIS

Results from designing for simplification.....







More power and less bulk—higher pressures and safer operation—greater speeds and less wear—more economical use of scarce materials . . . these are industry demands that every designer must meet—now!

Where simplification seems impossible because of sealing difficulties with—type of fluid handled, extent of pressures exerted, wide temperature changes, abrasion—have you considered the wide application possibilities of LINEAR "O" Rings?

A typical example of how LINEAR "O" Rings make design simplification possible can be illustrated by this redesigned relief valve. Here, *valuable metal was saved—five parts were eliminated—weight was reduced—production costs were reduced 22.4% . . . and most important, the profit margin on each unit was substantially increased.*

To build it better—to make it simpler—to provide a greater profit margin per unit . . . let LINEAR help you with your packing and sealing problems.

"PERFECTLY ENGINEERED PACKINGS"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK ST., PHILADELPHIA 35, PA

HOW TO GET THE MOST OUT OF Double-check

U-S-S Improved Heat Treatment is an improved method of quenching and tempering by means of violent agitation of the quenching bath. The basic engineering principles include quench tank design, and the definite size, number, placement and powering of the propellers.

THE ALLOY STEEL YOU'RE GETTING

your quenching methods

Here's how Jeffrey Manufacturing Company makes use of

U·S·S Improved Heat Treatment

—as told by Mr. C. S. Thomas, Chief Metallurgist

"We use U·S·S Improved Heat Treatment for batch hardening large parts, and continuously hardening small parts.

"We formerly had trouble with excessive and variable quench water temperature; this in turn caused uneven hardening. But now the U·S·S agitated quench process gives us uniform hardening almost without exception.

"It is now much easier to quench large parts, such as 100 pound alloy steel gears, because the man does not have to move the part. Instead, it hangs motionless in the quench while the agitated oil extracts heat rapidly and uniformly. The direct results are: increased production (less time needed for quenching), less chance for human error and more satisfactory hardening.

"Like many metallurgists, as soon as we have hardening trouble we look for trouble in the quench. U·S·S Improved Heat Treatment is providing an economical and efficient method of improving our quenching practice."

● Most of you who use alloy steel have one problem in common today; you must continue to turn out products of the same quality your customer is accustomed to, while using steels containing a smaller percentage of many of the important alloying elements.

To do this, many of you must look to new methods of developing the ultimate in mechanical properties in the leaner alloy steels. One of the best ways to get those maximum properties from leaner alloy steels is to make use of the best available heat treating practices. Utmost care must be given to *all* phases of heat treatment; heating, *quenching*, and tempering—keeping in mind the "H" value of *your* water or oil quench tank, and the hardenability of the steel you are using.

United States Steel Company has developed an improved agitated quenching method to give you better results with leaner alloy steels—or with most all steels for that matter. We call it U·S·S Improved Heat Treatment. The actual process includes quench tank design plus the definite size, number, placement and powering of the propellers that agitate the bath. This quenching method extracts the heat evenly and rapidly from the entire surface of the part.

Close to a hundred manufacturers are already using this improved quenching method, and without exception report better heat treating results. They cite the following advantages over methods which provide for no agitation or inadequate agitation of the quenching medium:

1. **Uniformity in mechanical properties throughout any one part and from one part to the next.**
2. **Deeper penetration of hardness with consequent higher over-all mechanical properties.**
3. **Reduction or elimination of retreats and rejections.**
4. **Reduction or elimination of warpage and cracking through uniformity of heat extraction.**

There is no charge for the use of this process. Furthermore, we will provide a metallurgical engineering analysis of your heat treating problems at no cost. It is simply part of our continuing effort to help you get the *most* out of the leaner alloy steels you're now getting.

UNITED STATES STEEL COMPANY, PITTSBURGH
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL SUPPLY DIVISION
WAREHOUSE DISTRIBUTORS, COAST-TO-COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

Carilloy Steels

ELECTRIC FURNACE OR OPEN HEARTH

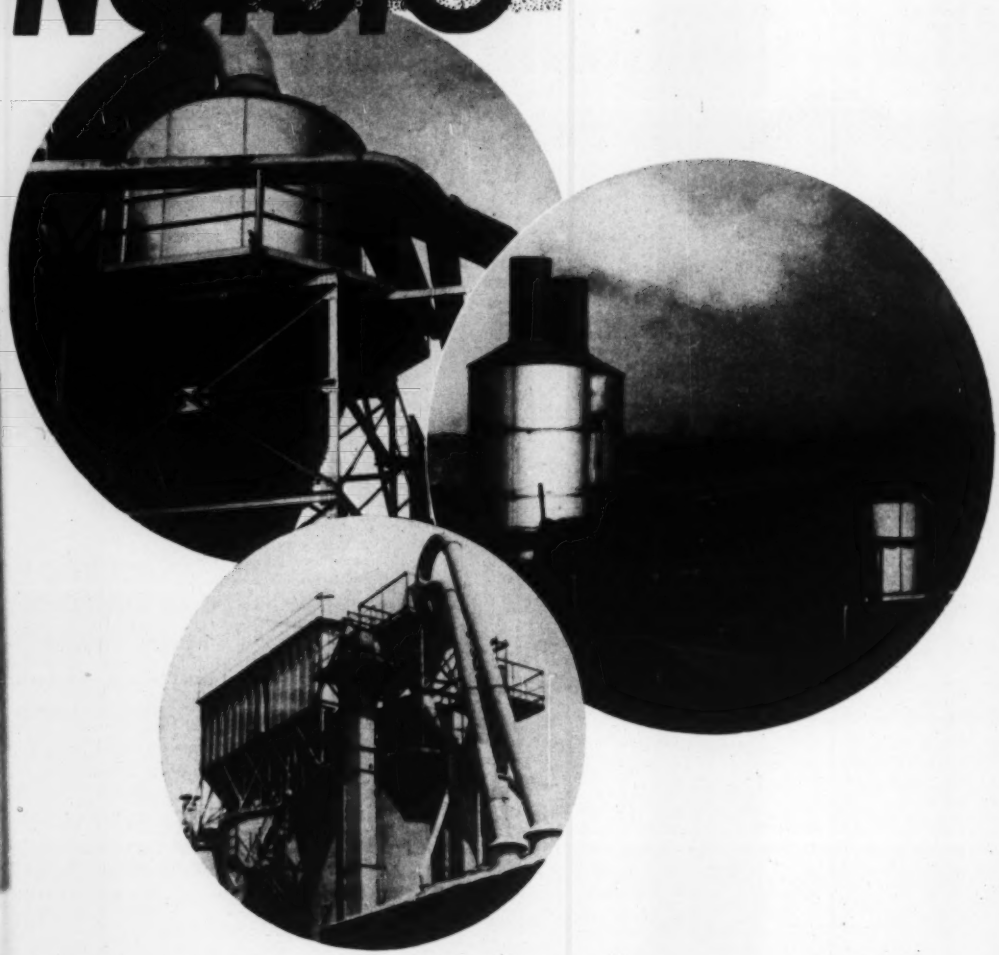
USS

COMPLETE PRODUCTION FACILITIES IN CHICAGO OR PITTSBURGH

1-1879

UNITED STATES STEEL

Norblo



Equipment for Better Dust and Fume Collection

Norblo dust collection equipment includes the three distinct types shown above—centrifugal, hydraulic, and bag type. While each type has advantages in specific conditions or applications, Norblo Automatic Bag Type is the wheelhorse for modern, large scale, heavy duty or continuous service. The largest installations of dust collection equipment in North America are fuming installations in the smelting field. Some of these move air by the millions of tons a year.

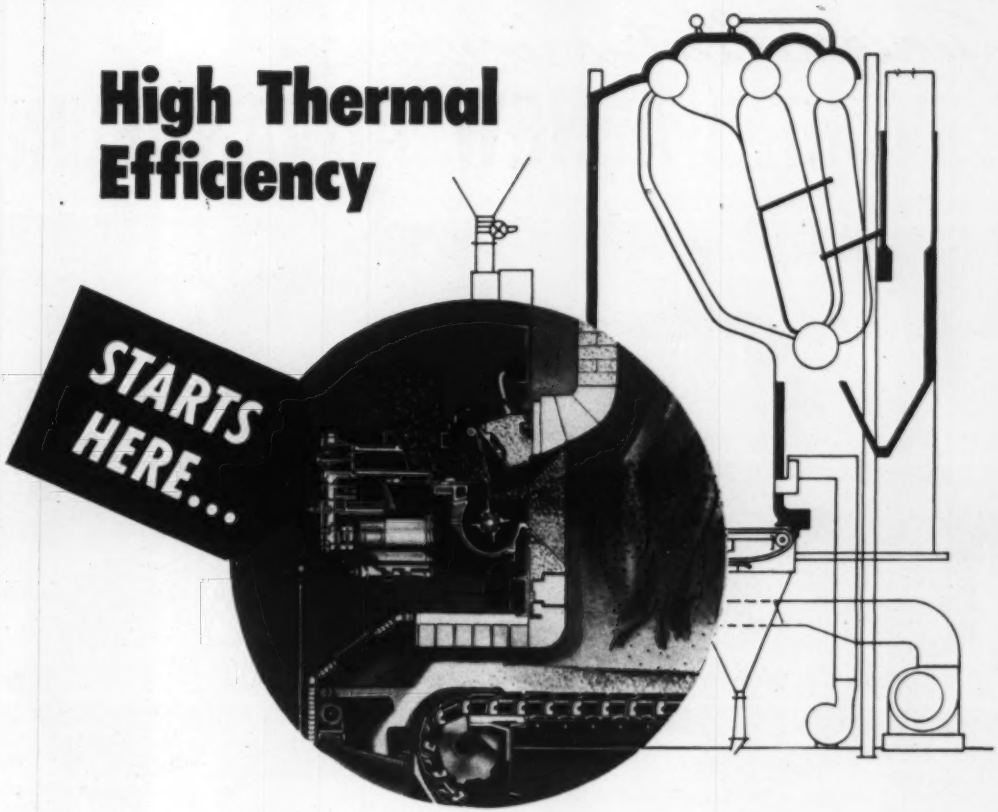
Up to the present moment no type of large scale dust or fume collecting equipment has proved itself more efficient, or lower in operating and maintenance cost in continuous large scale operation than Norblo Automatic Bag Type Dust Collectors. Get the facts.

THE NORTHERN BLOWER COMPANY

Engineered Dust Collection Systems for All Industries

6421 BARBERTON AVE. • CLEVELAND 2, OHIO

High Thermal Efficiency



It pays to choose your stoker carefully!

The coal-burning efficiency of your stoker is the starting point of coal saving . . . because the coal is all burned by the stoker and the coal bill is your major operating expense.

The burning of fuel for steam generation has always been one of the most exacting jobs that a machine can be called upon to perform. A stoker must operate twenty-four hours a day, seven days a week, for periods of six months or a year without a shutdown. The interior parts are exposed to heat and corrosion, the exterior mechanism to dirt and dust. A forced shutdown of the stoker may mean curtailment of production and cost the user many times the price of the stoker.

For over 60 years Westinghouse has maintained a consistently high standard of performance, while developing ever improved stokers to keep pace with the increasing demands of industry. And to make this assurance doubly sure, Westinghouse maintains a staff of experienced combustion engineers in all principal cities to make periodic inspections and give prompt attention to any operating problems.

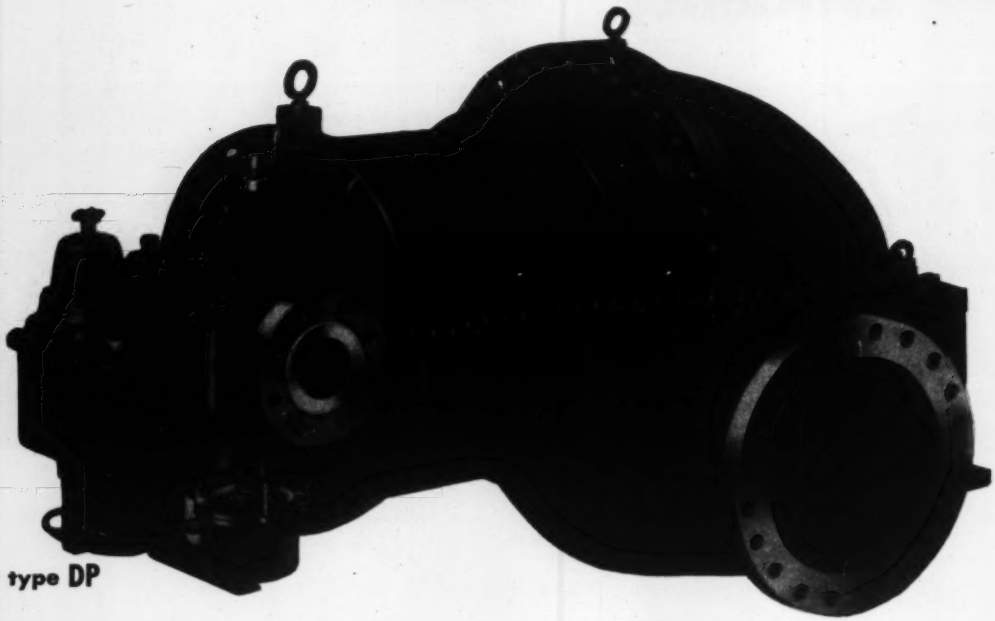
Before you invest, be satisfied you are buying the best stoker. Westinghouse offers a complete line of underfeed and spreader stokers for use with any boiler of your choice. Capacities range from moderate to over 400,000 lbs. of steam per hour. Get the full story. Call your nearby Westinghouse office . . . or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50525

YOU CAN BE SURE...IF IT'S Westinghouse

STOKERS

General Electric Announces

A NEW ADVANCE IN



type DP

Custom Performance from Standard Turbine Drives now possible through new Designs and Manufacturing Methods

Now you can select the mechanical-drive turbine that will give you maximum mechanical power for your fuel dollar . . . and without the delay and expense of special engineering. General Electric's four new multi-stage drives are *standards,* designed to meet your *specific* requirements.

Four new governing systems give you a wide selection of performance ratings. A new sectional valve gives you greater efficiency for part load operation. Many other improvements make these the finest turbines of their size General Electric has ever produced.

Secret of their adaptability is in the method of manufacture. By using interchangeable casting patterns, designed to be combined in a variety of ways, it's possible for the factory to "customize" standard machines for individual applications. You get a better turbine, designed for your job, and the delivery time is shorter, the cost lower.

Get the full particulars on these new multi-stage turbine drives. Write for our new bulletin, GEA-5580, "G-E Multi-Stage Turbine Drives." General Electric Company, Section 252-53, Schenectady, N. Y.

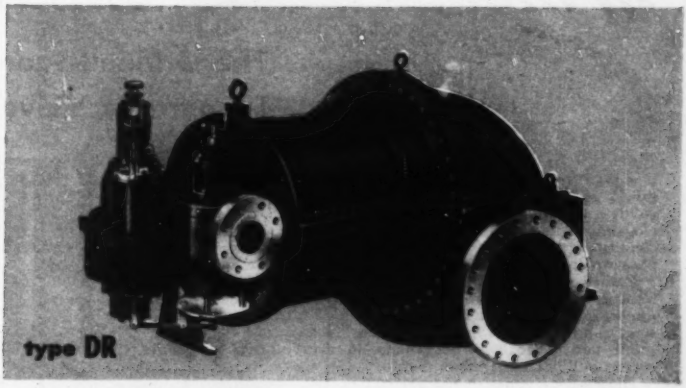
GENERAL ELECTRIC

252-53

MULTI-STAGE TURBINE DRIVES

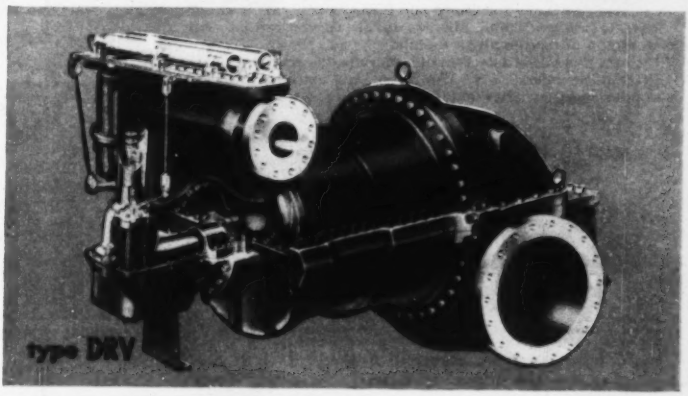
type DP

Dependable power over a 30 per cent adjustable speed range.



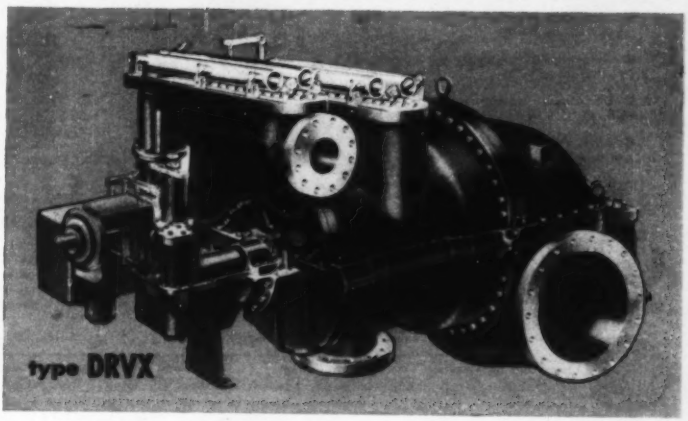
type DR

Oil-relay governor makes possible a speed range of 6 to 1, with only 4 per cent regulation and ½ per cent steady state speed variation.



type DRV

Automatic sectional valves linked to the oil-relay governor minimize throttling losses under fluctuating load factors, make possible substantial operating savings.



type DRVX

For applications where process steam is desired at a definite, steady pressure. Extracted steam pressure remains constant even when load on the unit fluctuates and the flow of extracted steam varies.

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Here's why . . . Piping in today's complex industrial plants is an exacting science involving the handling of highly corrosive fluids, gases, compressed air, beverages, foods and suspended solids . . . in lines where corrosion, abrasion, contamination, clogging, leakage and maintenance are costly factors. Under such conditions, the amazing adaptability of the Grinnell-Saunders Diaphragm Valve explains its acceptance by industry after industry.

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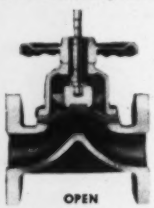
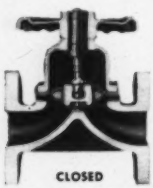
From this broad selection of materials, the problems which the Grinnell-Saunders valve can solve are extremely varied. No wonder industry after industry is putting it on the line.



Showing rising spindle . . . valves are available with rising or stationary spindle.



KEL-F diaphragm, using special rubber backing cushion and floating tube nut design.

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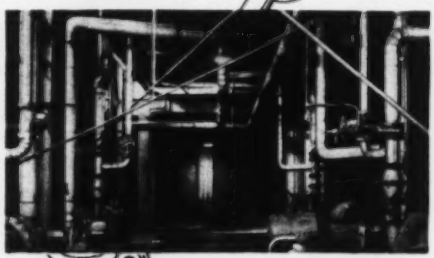
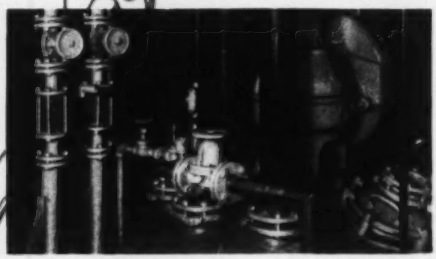
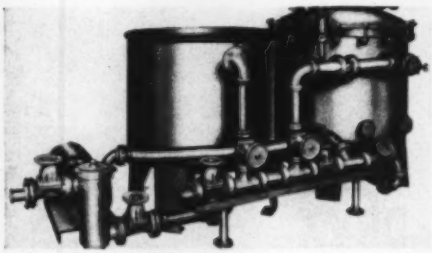


PULP AND PAPER MILL. Rubber-lined Grinnell-Saunders Valves on stainless steel piping handle sulphate pulp stock in bleach plant of Potlatch Forests, Inc., Lewiston, Idaho.



CHEMICAL PLANTS. Glass-lined Grinnell-Saunders Diaphragm Valves, with KEL-F diaphragms, handle chlorinated organic chemicals at Hooker Electrochemical Company, Niagara Falls, N. Y.



EQUIPMENT MANUFACTURERS. Grinnell-Saunders valves with rubber linings are standard on filtration equipment for solution clarification, made by Industrial Filter & Pump Mfg. Co., Chicago, Ill.

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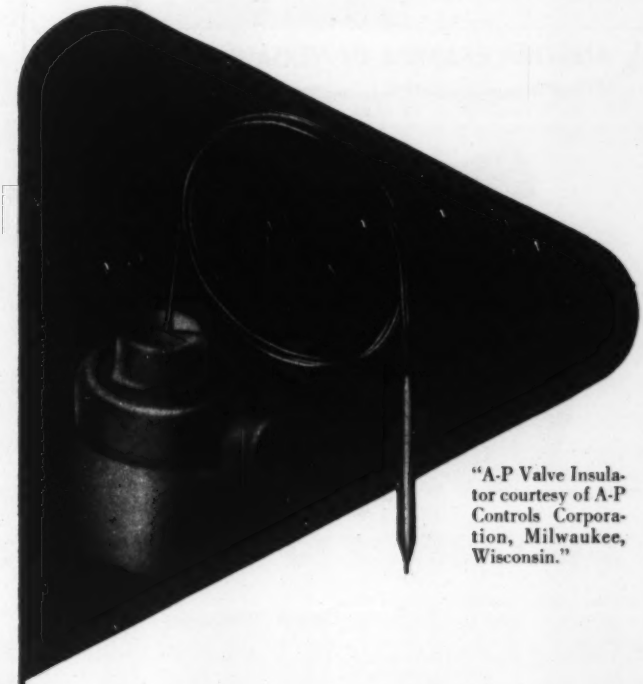

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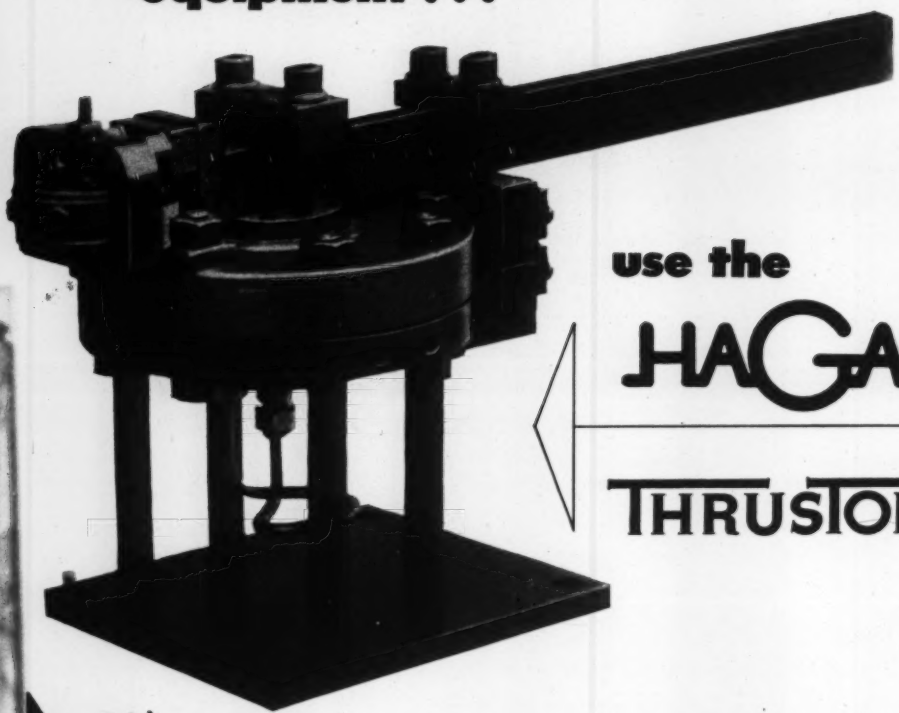

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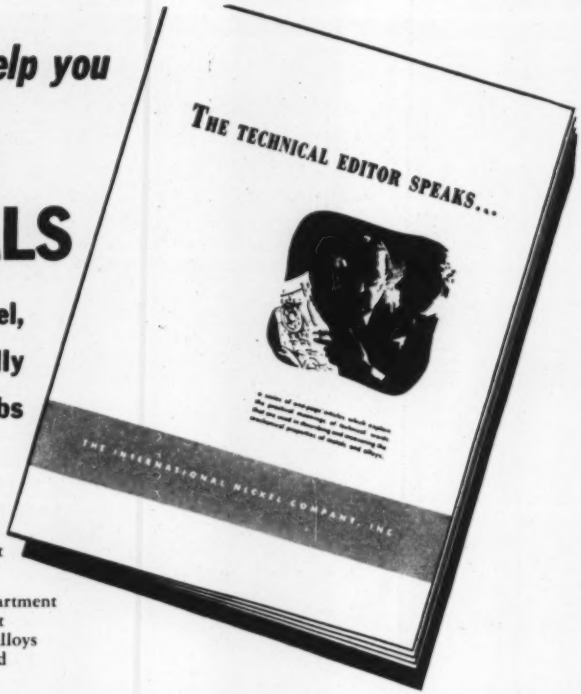

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MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 74 NUMBER 2

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Published monthly by The American Society of Mechanical Engineers. Publications office at 20th and Northampton Streets, Easton, Pa. Editorial and Advertising departments at the headquarters of the Society, 29 West Thirty-Ninth Street, New York 18, N. Y. Cable address, "Dynamic," New York. Price to members and affiliates one year $3.50, single copy 50 cents, to nonmembers one year $7.00, single copy 75 cents. Extra postage to countries not in the Pan-American Union, $1.50; to Canada, 75 cents. Changes of address must be received at Society headquarters four weeks before they are to be effective on the mailing list. Please send old as well as new address. . . . By-Law: The Society shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications (B13, Par. 4) . . . . Entered as second-class matter at the Post Office at Easton, Pa., under the Act of March 3, 1879 . . . Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on January 17, 1921. . . . Copyrighted, 1952, by The American Society of Mechanical Engineers. Member of the Audit Bureau of Circulations. Reprints from this publication may be made on condition that full credit be given MECHANICAL ENGINEERING and the author, and that date of publication be stated.

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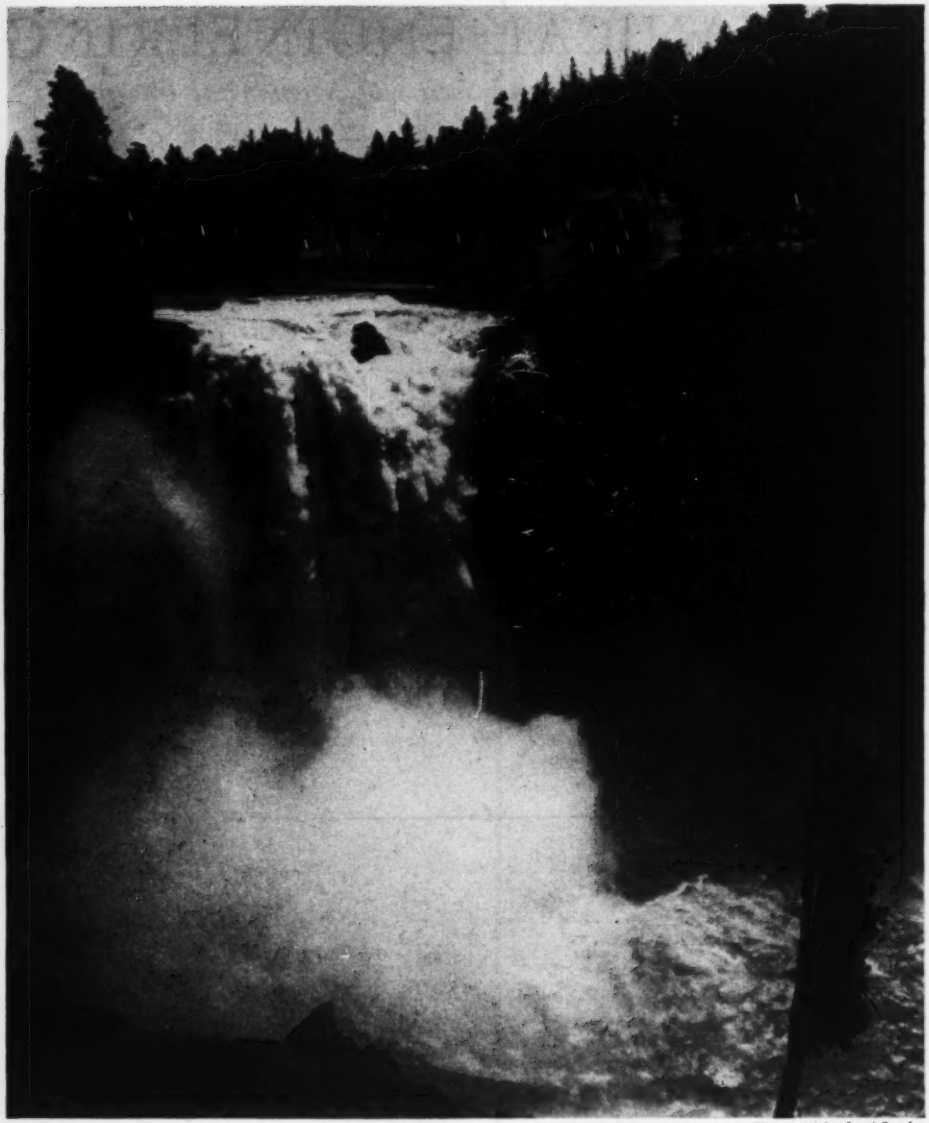

Photograph by Josef Scaylea

Snowqualmie Falls, only 29 Miles by Car From Seattle, Wash., Where the ASME Spring Meeting Will Be Held March 24–26, 1952

VOLUME 74
No. 2

MECHANICAL ENGINEERING

FEBRUARY
1952

GEORGE A. STETSON, *Editor*

Centennial of Engineering

WHEN The American Society of Mechanical Engineers convenes in Chicago, Sept. 8 to 11, 1952, its members will find the city filled with engineers from all parts of the world in attendance at many engineering meetings being held in connection with the Centennial of Engineering, in the United States, commemorating the one-hundredth anniversary of the American Society of Civil Engineers.

In order to observe in an appropriate frame of reference this significant milestone in the history of our nation, a Convocation has been planned to run from September 3 to September 12, inclusive, with a program of addresses by eminent speakers and specialists, which will endeavor to depict the effects that engineering has had on the economic, social, and political life of the nation and the progress which has taken place, sketched in broad terms, in essential areas of engineering practice. These addresses should assist in broadening the public understanding of civilization's debt to engineers and engineering, and they should bear eloquent testimony of the extent to which engineering has aided in the development and maintenance of the American way of life—the free-enterprise system on which our society has prospered in the past—and the reasons for the high standard of material well-being which is enjoyed by our citizens.

With the United States thrust by the pressure of international events into a position of leadership in most areas of present-day affairs and with the current conflict of social, economic, and political systems engaging the almost complete attention of the world, the addresses will afford an opportunity to review some of the elements of our might, to renew our faith in the effectiveness of the system of government under which our rapid progress was possible, and to strengthen our determination to preserve what has been won at so great a cost and extend its influences to peoples made weak and discouraged by ruinous wars and social change or brought into the orbit of modern civilization by the destruction of their former isolation through the very means by which our own continent was made prosperous.

It has been our good fortune to attract to this continent over the past three centuries people, ideas, and materials not found here in abundance, and to put them all to work in an environment relatively free of the limitations of food supply, living area, natural resources, and social and political systems that have caused unrest and frustration in the older civilizations of Europe. To all our citizens from the Pilgrim Fathers to the most recent "displaced persons" reaching our shores, America has been the land of promise; and to most persons who were part of the great migrations of the seventeenth, eighteenth, nineteenth, and twentieth centuries, or to their descendants, that promise has been fulfilled. What has been accomplished here has not been done by any one group from any one locality in the rest of the world, but by all. The intelligence, ambition, hard work, and frugality of hundreds of thousands of individuals have responded to the fructifying influences of personal liberty, free institutions, and concern for public welfare and human dignity. And as engineering has spread the benign effects of science into the homes and workshops of the nation, the essential needs of physical life have been met, the hours devoted to the necessities of bare existence have decreased, human comfort and the amenities of cultural advance have been made abundant and secure, and the productivity of the individual, exceeding that of any other groups, has overflowed into those parts of the world where it is sorely needed.

In that famous third chapter of his "History of England," first published about the time the American Society of Civil Engineers was organized, Macaulay, impressed with the benefits of productivity as he assessed them in his native land, wrote: "No ordinary misfortune, no ordinary misgovernment, will do so much to make a nation wretched, as the constant progress of physical knowledge and the constant effort of every man to better himself will do to make a nation prosperous. It has often been found that profuse expenditure, heavy taxation, absurd commercial restrictions, corrupt tribunals, disastrous wars, seditions, persecutions, conflagrations, inundations, have not been able to destroy capital as fast as the exertions of private citizens have been able to create it."

Is there not today before us a complex of conditions, terrifying and discouraging to many of us, that give to Macaulay's optimistic observations on economic progress a timely significance? In that chapter from which the foregoing quotation was taken, Macaulay compared the conditions existing in England in 1848 with those of the Restoration. The contrast must have been heartening to the readers of a century ago, for contrast accentuated the progress that had been made in the interval. Macaulay's readers had the essentials of life—food, shelter, clothing, means of communication and transportation, tools to work with, and sources of energy to augment their physical powers. The England of Macaulay's day was plagued with most of the misfortunes he enumerates, even as we are today. But when we consider the contrast which would be drawn by a

comparison of conditions in the United States or England today and those of a century ago, we discover that most of the aids to modern living that seem essential to us were unknown to him. Surely his words have been fulfilled. The "constant progress of physical knowledge," "the constant effort of every man to better himself," "the exertions of private citizens" to create capital have made that startling contrast possible.

And yet, we are likely to forget all this in the darkness of our current despair. We are likely, if we do not correct ourselves, to lose faith in those great forces of physical knowledge, in our efforts to better ourselves, and in our ability to create capital faster than it is destroyed through human folly. The Convocation at Chicago, designed to direct attention toward these very influences and to restore our faith and perspective, will show us and our lay brothers what engineering has done—and still can do—in our system, to prove the truth and sanity of Macaulay's observations of a century ago.

ASME Development Fund

OUT of the relationships of the engineer to his professional society, there grows a sense of loyalty to that society, a sense of gratitude for aid rendered and opportunities offered, a sense of satisfaction in achievements impossible for the individual to attain alone, a sense of pride in "belonging," and a sense of obligation to live up to the high hopes held by the society that, through its members, it may ably serve the public welfare.

As the value and significance of these relationships are recognized, the member welcomes opportunities to identify himself as closely as possible with his society, through contributions of time and money.

Every member of The American Society of Mechanical Engineers has recently been given an opportunity to contribute to the ASME Development Fund. Of course he pays his dues and probably gives of his time and services as well, for without those essentials no society can exist. He has a right to expect—to demand—thrifty and intelligent use of his money and time devoted to a common cause. But if he has vision, he may realize that the Society, like the individual member, if it is to live up to responsibilities of service beyond obvious obligations to its members and the nation, must have the courage, the zeal, the will, and the facilities to expand its usefulness and venture into fields and projects that should not be financed by dues. The ASME Development Fund exists for this purpose. In the past, corporations have provided the money for the Fund. They will provide the major share of the contributions now being solicited. But this time the individual member is being given an opportunity to make at least a token acknowledgment of his conviction that professional societies, as well as professional men, must assume extraordinary responsibilities to the public welfare. The ASME Development Fund gives every member a chance to make that acknowledgment.

Scrap

YEAR-END reports of the extraordinary achievements of the steel industry for 1951 stress a high rate of production—it is said that steel mills in the United States operated above rated capacity for 42 of the 52 weeks—increase in steel-producing capacity, expected to continue throughout 1952, and the threats to continued record tonnage in the form of possible labor troubles and shortages of some materials, notably scrap.

In the technical operations of the steel industry and the building of new plants, mechanical engineers associated with these projects are fully engaged and need no reminders of the importance and urgency of their work. In the settlement of disputes with labor in the steel industry, the average ASME member has no specific role to play. But in the drive to get in the scrap so that steel production can be maintained at a high level, practically everyone, if he keeps his wits about him and is impressed with the urgency of the situation, can be of more help than he might imagine. For as Manly Fleischmann, administrator, Defense Production Administration and National Production Authority, said at a press conference recently held in Washington, "Wherever there is business, there is scrap."

Several months ago in this space the suggestions of the American Iron and Steel Institute, applicable to any concern regardless of the amount of scrap that it might contribute, were offered as a practical program of action. They are repeated here:

"Go after dormant scrap. Start an emergency inspection and inventory of all heavy steel, whether machines, equipment, beams, or plates. Sell everything you can possibly spare to your nearest scrap dealer.

"Keep the scrap flowing. Organize a cleanup committee, if you do not already have one.

"Make organized permanent salvage a top-management responsibility. A big burst of enthusiasm may solve the steel-production rate right now, but the problem will be continuous.

"Put scrap collection on a housekeeping basis. Besides increasing the steel supply, continuous scrap recovery of obsolete machines and equipment reduces taxes through inventory write-off, improves safety conditions, gives lowered insurance rates, and clears valuable space."

The program of scrap-recovery, although set up with the particular urgency of the shortages in the steel industry in mind, is equally applicable to recovery of all the scarce materials so desperately needed for defense and domestic production—copper, bronze, brass, aluminum, lead, and zinc.

The job of rounding up scrap is not too small to demand the best efforts of top executives nor is it too big to exclude every one down the line, particularly engineers, who, through intimate knowledge of plant conditions and requirements, may be able to point out obsolete machines ripe for scrapping. Urgency of the need compels wholehearted effort. It's a campaign in which every one benefits.

MODERN REHEAT TURBINES

Service Experience and Recent Design Progress

By CARL SCHABTACH[1] AND RAYMOND SHEPPARD[2]

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

INTRODUCTION

THE growth in size of utility systems and the rising cost of fuel and labor emphasize the desirability of larger units of maximum efficiency consistent with reliability and economical cost. The result is a high level of progress in the development of all components of power-generating equipment, utilizing generally higher pressures and temperatures, the reheat cycle, and 3600-rpm units substantially larger than any heretofore built.

The most common initial steam conditions for turbines rated 20,000 kw and above shipped by the authors' company in 1948, were 850 and 1250 psi, 900 and 950 F, while such turbines scheduled for shipment in 1953 are being built mostly for initial steam conditions of 1450 or 1800 psi and 1000 or 1050 F. Moreover, most of these turbines for 1953 shipment will employ reheat at 1000 F. The rapidity and extent of the adoption of reheat and the sharp upward trend in size of 3600-rpm units is illustrated by the summary (Table 1) of turbines rated 20,000 kw and above, shipped or scheduled for shipment during the period 1948–1953.

TABLE 1 TURBINE SHIPMENTS SCHEDULED 1948–1953

Year of shipment	Average rating of 3600-rpm units, kw	Per cent of total rating for reheat
1948	39000	0
1949	43900	9.4
1950	52400	26.3
1951	51700	27.5
1952	68500	60.6
1953	76800	71.8

While the demand for larger 3600-rpm units has been met to a large extent with units rated less than 100,000 kw, it has promoted the development of units considerably larger. Noteworthy examples of these will be described after reviewing experience with reheat turbines recently placed in service.

Simplicity and economy of installation and operation of modern unit boiler-turbine reheat plants, consistent with reliability and efficiency, have been the goal of plant designers and turbine and boiler manufacturers. Its successful attainment has been an important factor in the recent trend to reheat. In this and other respects, experience to date has confirmed the soundness of this objective and the means by which it was accomplished.

GENERAL FEATURES OF TURBINES IN SERVICE AND OPERATING EXPERIENCE

At the time of writing (July, 1951), there are five modern 125,000-kw (150,000-kw maximum capacity) cross-compound reheat units in operation in the Philip Sporn and other stations of the American Gas and Electric Company system, the first of which was placed in service in November, 1949. Initial steam conditions are 2000 psi, 1050 F, with 1000 F reheat. Cross sections of the 35,000-kw, 3600-rpm high-pressure turbine and the 90,000-kw, 1800-rpm tandem-compound double-flow low-pressure turbine are shown in Fig. 1. Austenitic materials were used for all parts at 1050 F.

In addition, there are in regular operation ten tandem-compound double-flow 3600-rpm reheat units in ratings from 50,000 kw to 80,000 kw, the first of which was placed in service at the Dunkirk Station of Niagara Mohawk Power Corporation in September, 1950. Eight of these have initial steam conditions of 1450 psi, 1000 F, with 1000 F reheat, while two are for 1250 psi, 950 F, with 950 F reheat. A cross section of the 80,000-kw turbine is shown in Fig. 2.

In addition to the controls customarily required for nonreheat turbines, both these types of reheat turbine require (*a*) an intercept valve to stop the flow of steam to the turbine from the reheat section of the boiler in case of sudden rejection of load; (*b*) means to cool the low-pressure section of the turbine and the condenser during light load operation; and (*c*) means to protect the reheater following sudden loss of load. Cooling of the low-pressure section is accomplished with water sprays in the crossover from the intermediate to the double-flow low-pressure section of the turbine. Protection of the reheater against overheating is accomplished by automatic reduction of the boiler firing rate, using electrical contacts on the turbine valves.

Efficiency. Heat-rate tests have been conducted on one of the Sporn-type cross-compound units and on two of the Dunkirk 3600-rpm, tandem-compound type. Guarantees in all cases have been met or bettered.

Performance of Speed-Governing System. To demonstrate operation of the governing mechanism, loads of 100,000 kw were dumped three times from one of the Dunkirk units. Auxiliary power of approximately 2000 kw remained connected to the generator. The excellent performance is illustrated in Fig. 3. The speed of the unit reached a maximum of 106.5 per cent and settled at 105 per cent within 10 sec, and for about 2 min the 2000-kw auxiliary load was carried on the steam stored in the reheater. The unit was resynchronized with the system in about 4½ min. It was not equipped with an automatic runback relay on the main operating governor synchronizing motor; however, the operator energized the speed-changer motor manually to lower its speed range just as soon as the circuit breaker opened.

All the coal mills were tripped automatically by action of switch contacts provided on the high-pressure control-valve operating cylinder near the closed position; however, oil torches remained in service. The temperature of the steam from the reheater started dropping slowly immediately after the load was dumped.

Similar tests have been made and several accidental load dumps have occurred on other units of this type in service,

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[2] Assistant Division Engineer, Steam Turbine Engineering Division. Mem. ASME.

Contributed by the Power Division and presented at the Annual Meeting, Atlantic City, N. J., November 25–30, 1951, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

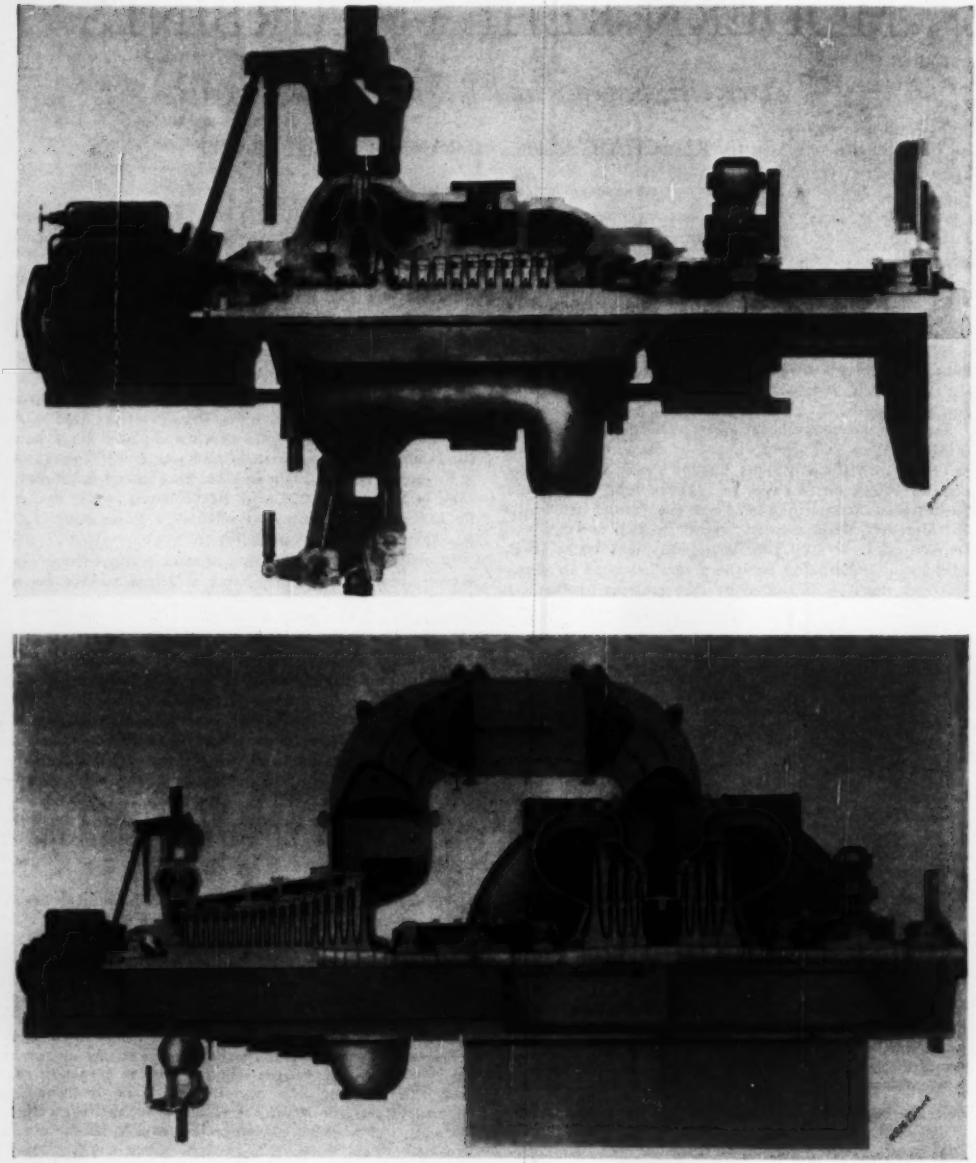


FIG. 1 35,000-KW 3600-RPM HIGH-PRESSURE TURBINE AND 90,000-KW 1800-RPM TANDEM-COMPOUND LOW-PRESSURE TURBINE OF 125,000-KW CROSS-COMPOUND REHEAT TURBINE FOR 2000 PSI, 1050 F INITIAL AND 1000 F REHEAT TEMPERATURE

and the performance of the governing mechanism has been consistently satisfactory and in accordance with expectations.

Iron-Oxide Deposits on Valve Stems. Isolated cases of iron-oxide build-up on the stems of stop and control valves have been encountered for many years. It has been our experience that this is more likely to occur during the first year of operation and, once the stems have been cleaned, there is seldom a recurrence of the deposit to a troublesome degree. Although there is some disagreement as to the source of this iron oxide, we believe that it is carried in the steam and is deposited along the stems where throttling occurs.

More than the usual number of such cases of valve stem sticking have occurred on the new 1000 F turbines. Some of the stems of the control valves of the first units installed in the Sporn and Dunkirk Stations were observed to be sticking after a few months of operation, and it was necessary to disassemble the valves to clean the stems.

In connection with this problem, it has been observed that the steam supplied to many of the recent reheat turbines during the start-up period was particularly rich in black iron oxide and pipe scale, to the extent that in some cases the steam blowing out from the seals and drains was black. In other cases the iron oxide and scale were deposited on the buckets and diaphragms and built up under the bucket covers of the latter stages to depths as great as $^3/_{16}$ in. This occurred only where the boiler and main steam lines had not been blown down with 200 to 300-psi steam prior to starting. It is strongly recommended that provision be made to do this and that it be done before starting new high-temperature plants. Where it has been done the results have been excellent.

Modifications to Intercept Valves. In May, 1951, iron-oxide deposits on the intercept-valve stems of one of the Sporn low-pressure units prevented complete closure of these valves following accidental operation of the differential relay which removed field from the generators and tripped the stop valves ahead of the high-pressure unit. Steam stored in the reheater carried the speed of the low-pressure turbine and generator up to 40 or 50 per cent above normal. The high-pressure unit did not overspeed. It was found that black oxide had built up on the stems and bushings, closing up the 6 to 8 mils original clearance and causing one of the valves to stick partly open and stall the hydraulic cylinder operating this and the three other cam-operated valves. The only damage to the unit was the loss of several sections of cover from the last-stage buckets. A careful inspection of the generator field and other parts of the rotors revealed no other damage.

To prevent recurrence of such misoperation, all of the Sporn-type units now in service or in process of manufacture will be modified as follows:

1 The four intercept-valve stems will be rebuilt to incorporate the stem-sealing feature regularly used in emergency stop valves. The construction is illustrated in Fig. 4. The seal prevents the flow of steam between the valve and bushing

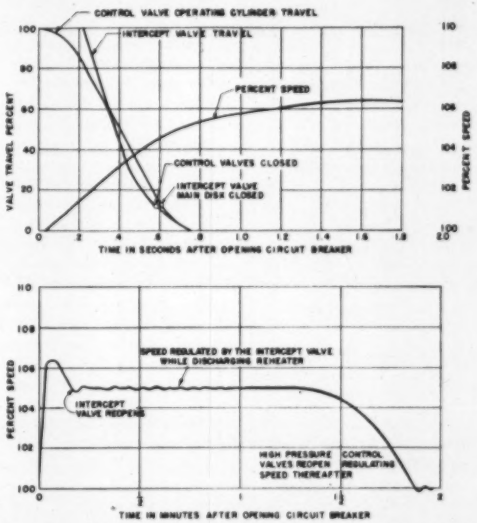

CONTROL VALVE OPERATING CYLINDER TRAVEL
INTERCEPT VALVE TRAVEL
PERCENT SPEED
CONTROL VALVES CLOSED
INTERCEPT VALVE MAIN DISK CLOSED
VALVE TRAVEL, PERCENT
PERCENT SPEED
TIME IN SECONDS AFTER OPENING CIRCUIT BREAKER
SPEED REGULATED BY THE INTERCEPT VALVE WHILE DISCHARGING REHEATER
INTERCEPT VALVE REOPENS
HIGH PRESSURE VALVES REOPEN
CONTROL REGULATING SPEED THEREAFTER
PERCENT SPEED
TIME IN MINUTES AFTER OPENING CIRCUIT BREAKER

FIG. 3 RECORD OF SPEED AND VALVE TRAVEL IMMEDIATELY FOLLOWING 100,000-KW LOAD REJECTION WITH 2000-KW LOAD REMAINING ON 80,000-KW 3600-RPM TANDEM-COMPOUND DOUBLE-FLOW REHEAT TURBINE

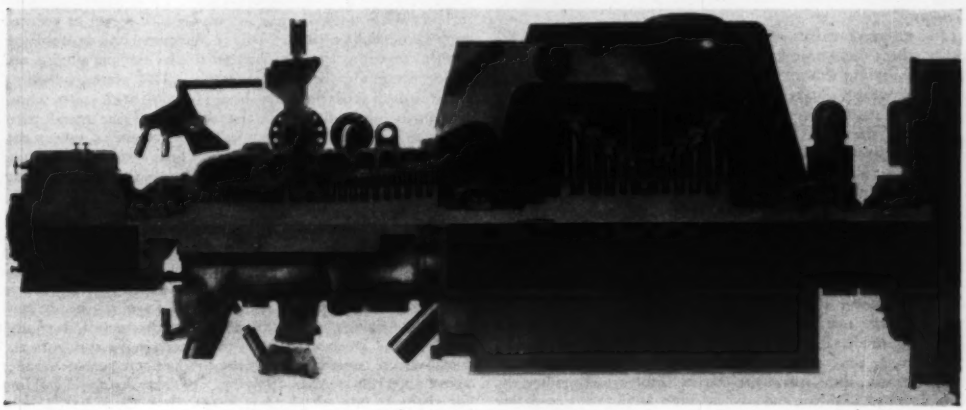


FIG. 2 80,000-KW 3600-RPM TANDEM-COMPOUND DOUBLE-FLOW REHEAT TURBINE FOR 1450-PSI 1000 F INITIAL AND 1000 F REHEAT TEMPERATURE

when the valve is open. Since the valve is wide open at all times, except during momentary testing or under emergency conditions when the steam leakage is of no significance, the clearance between the stem and bushing can be increased. Both the seal and the larger clearance help prevent sticking.

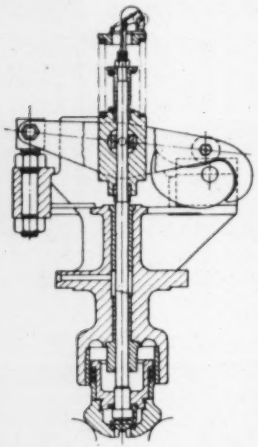


FIG. 4 INTERCEPT VALVE WITH STEM SEAL FOR CROSS-COMPOUND REHEAT TURBINES

2 The valves will be tested fully closed once a week to make sure they are fully operative. The valves can be fully closed momentarily with about 50 per cent load on the unit, without an appreciable rise in steam pressure in the reheater. Originally, provision was made for a partial closure test, and such testing had been done as recommended.

3 A nonreturn valve has been installed in the line between the high-pressure heater and the discharge from the high-pressure turbine. Of the calculated 52 per cent potential overspeed of the low-pressure units due to stored thermal energy above the intercept valves, only 34 per cent is due to the steam in the reheater and the remaining 18 per cent is chargeable to water and steam in the high-pressure heater.

4 Although the desuperheating water sprays in the boiler ahead of the reheater were found to have contributed in no way to the overspeed reached by the low-pressure unit, it is desirable that such water valves be interlocked with the turbine emergency governor so as to reduce to a minimum the possible overspeed in the reheater system. These air interlocks have been added to the Sporn units and will be recommended for all reheat units manufactured by the authors' company.

The intercept valves of the Dunkirk-type units and of all other reheat units now being manufactured are equipped with the stem-sealing feature. To facilitate testing, these are fully closed at weekly intervals; they will be modified slightly to provide a testing lever for this purpose. The intercept valves of one of the 80,000-kw Dunkirk units were fully closed momentarily while the unit was carrying 50,000 kw without appreciable rise of the reheater pressure. Where two separately operated intercept valves are provided, one valve can be closed momentarily with full load on the unit.

Control of Exhaust Temperature During Light Load Operation. Exhaust-temperature measurements on one of the 80,000-kw Dunkirk units show that the rate of temperature rise of the exhaust at full speed, no load, with the desuperheating sprays in the crossover shut off is 10 F per min, with inlet and reheat steam temperatures both about 700 F. Conditions following sudden loss of all or a large part of full load are still more severe, since the reheat temperature drops quite slowly. Consequently, these sprays are started automatically when the load drops to 2000 kw, and are turned on during starting before the exhaust temperature begins to rise. In the case of similar 60,000-kw machines, having a shorter bucket in the last stage, use of the desuperheating sprays appears to be unnecessary during starting when the reheat temperature is low. The need for desuperheating depends upon the windage loss in the latter stages of the turbine and on the reheat steam temperature. The rate of exhaust-temperature rise of the Sporn-type 1800-rpm low-pressure turbines is moderate, so the sprays can safely be operated manually.

The operation of these desuperheating sprays has been completely successful; these reheat machines may be operated continually at no load without overheating the exhaust. There has been no evidence thus far that normal use of such sprays will cause excessive erosion of the buckets.

Parts Made From Austenitic Steels. The generally satisfactory performance of austenitic stainless-steel parts at 1050 F in the Sporn-type turbines has justified the choice of this material from those available when the units were designed; however, the record is not perfect, and the troubles encountered are presented to make available the experience gained.

The high-pressure double-shell turbine of one of these units was opened for inspection after about 6 months of operation. No difficulty occurred in removing the stainless-steel studs and nuts, and there was no evidence of galling. Ultrasonic inspection of the austenitic main steam pipes indicated that they were free from cracks. The forged stop-valve bodies and the cast inner shell and other high-temperature parts were in generally excellent condition.

The unit was opened primarily to install new sealing rings to stop leakage at the slip-type expansion joints between the austenitic steam-inlet pipes and the valve chest on the inner shell. The new rings are of a different material having much higher yield strength. To resist the consequent greater sliding pressures, they were surface-hardened and the surface of the pipe was Stellited. After more than a year of operation, inspection and measurement of the rings indicate this solution is satisfactory.

After about 18 months of operation of another of these turbines, a crack developed in the lower left-hand forged inlet-pipe connection at the weld between this flanged connection and the pipe, causing a small blow of steam to the room. The crack started at a point of stress concentration created by the weld preparation. An improved construction, with the weld relocated in a region of lower stress, will replace all such austenitic joints.

Starting and Loading Characteristics. Cold starts of reheat turbines with single boilers are made with steam at reduced temperature and pressure. This is convenient and desirable; it permits bringing the temperature of the turbine piping and boiler up gradually and uniformly. Hot starts following shutdowns of short duration should be made with steam whose temperature is close to the temperature of the metal parts near the inlets. Considering only the turbine, a reheat turbine may be brought to speed as quickly as a nonreheat turbine of comparable size and design, and it may be loaded at the same rate if the reheat temperature is controlled as accurately as the initial temperature.

Cold starts of the cross-compound units are generally made with steam at about 400 psi and 500 F, after the two generators have been tied together electrically on the turning gear. They are brought quickly to half speed to establish good vacuum and held at this speed for about 1 hr to warm the heavy castings and forgings. They are then brought to full speed and synchronized in about 30 min. Desuperheating sprays in the crossover are turned on when the low-pressure turbine reaches about 1500 rpm. After applying 30,000-kw load and holding for about 15 min, the load is increased in about 3 to $3^1/_2$ hr to 150,000 kw. This time could be halved without impairing the turbine performance or increasing maintenance.

Following a short shutdown, these units have been started

and synchronized in 10 min and fully loaded in another 10 to 20 min, depending upon the steam and metal temperatures.

One of the 80,000-kw turbines at Dunkirk was fitted with thermocouples at various locations in the initial and reheat sections of the high-pressure turbine to measure the rate of change of temperature of the flanges, flange bolts, steam-inlet pipes, and inner and outer shells during starting and load changes. With normal steam pressure and temperature, sudden changes of 20,000 kw in load in the range 20,000 to 100,000 kw caused no significant change in differential expansion or steam or metal temperatures. Load was increased from 20,000 to 100,000 kw at the rate of 5000 kw per min without excessive differential expansion or metal temperature differentials. Following a week-end shutdown, with maximum turbine-metal temperatures in the neighborhood of 400 F, the unit was brought to speed and synchronized in about 30 min and then loaded at various rates up to 3000 kw per min. Initial steam pressures were in the range 600 to 1000 psi. The results of these tests had not been analyzed completely at the time of writing, but they will be reported later. Preliminary indications are that starting and loading at these rates is feasible if the reheat steam temperature is controlled adequately.

RECENT DESIGN PROGRESS

Before discussing in detail typical turbines designed recently for higher capacities, pressures, and temperatures, attention is called to the following features which they possess in common:

1 Where both initial and reheated steam are admitted to the same casing, the admissions are immediately adjacent, with flow in opposite directions through the turbine to the reheater and condenser, respectively. This opposed-flow construction, first used in the 80,000-kw tandem-compound double-flow reheat design, concentrates the highest temperatures in a small region of the high-pressure casing to minimize temperature differentials and the resulting tendency to distortion. In addition, the thrust is partially balanced, and the highest-temperature parts are removed from the vicinity of the seals and bearings. No problem has been encountered or is anticipated due to the pressure difference between the initial and reheat inlets.

2 Where the high-pressure section above the reheat point of tandem-compound turbines is in a separate casing, the direction of steam flow through this section is opposite to that through the section following the reheat point. The thrust bearing is located between the high-pressure and reheat-turbine casings, thus reducing the amount of differential expansion between the rotating and stationary parts; this is particularly effective in the high-pressure stages of the initial and reheat sections where the radial heights of the buckets and nozzles are small.

3 Ferritic materials are employed for shells, pipes, and valve bodies at 1050 F rather than the austenitic materials used earlier at this temperature. Steam cooling of a few of the inner-shell horizontal flange bolts is used as required to keep stresses within allowable limits for ferritic bolting steels. Austenitic materials are employed only for valves, valve stems, and bushings, where their superior corrosion resistance is necessary, and for the accompanying valve stands which must have the same thermal-expansion characteristics.

4 Double-shell construction is used for the high-pressure, high-temperature sections both above and below the reheat point when required by stress and temperature considerations.

5 The control system is basically the same as that developed initially for the 80,000-kw, 3600-rpm tandem-compound double-flow, and the 125,000-kw cross-compound units.

6 The several high-pressure and low-pressure turbines are suitable for combination in a variety of arrangements, tandem or cross-compound, covering a wide range of capacities.

The cross sections of several of the turbines to be discussed show steam seals. These are being furnished on a few large machines at the request of the purchaser to simplify operation, but our standard practice on units for central-station service is to use water seals. We have furnished steam seals for a number of machines of 10,000 to 15,000 kw rating, and these have performed with no trouble whatever. However, they require a somewhat longer span between bearings as compared to water seals, and they allow more heat to flow through the shaft into the bearings and oil deflectors with some risk of carbonization on deflector teeth. We believe that these problems can be handled adequately by proper design.

Tandem-Compound With Triple-Flow Exhaust. The triple-flow exhaust is used for ratings in the range 100,000 to 150,000 kw where warranted by the combination of vacuum and capacity. These triple-flow machines have been designed with the high-pressure turbine in a separate casing, because the longer span resulting from the addition of the third tandem section required another bearing, and the most advantageous location for it is between the high-pressure and reheat sections.

The first machine of this type was purchased by the Public Service Company of Northern Illinois for the Waukegan Station and is rated 110,000 kw 3600 rpm with initial steam conditions of 1800 psi, 1000 F with 1000 F reheat. It is expected that this unit will be placed in service about the end of 1951. At the time of writing, 22 machines of this type were on order in ratings of 100,000 to 150,000 kw and for initial steam conditions of 1800 psi, 1000 and 1050 F, with reheat to 1000 F.

A typical cross section is shown in Fig. 5. Steam flows through the high-pressure turbine toward the front standard and after reheating is admitted to the intermediate casing through two intercept valves, both located on top. This location of the intercept valves is a modification of the Waukegan design in which there are valves both top and bottom, and may appear at variance with our standard practice of providing control valves both top and bottom to obtain mechanical symmetry and uniformity of thermal expansion. However, these intercept valves differ from control valves in that they always admit steam to the full arc of the casing, and they are always fully open so long as the turbine is in operation, except for short periods under emergency conditions when they are performing their function of stopping the flow of steam from the reheater. Location of these valves on the top only greatly simplifies the piping underneath, and by keeping the valves on the shell without connecting piping, the storage of steam below the intercept valves and the amount of energy available in such steam to cause overspeeding after the valves are closed is reduced.

For higher initial and reheat steam temperatures, the high-pressure section is modified as shown in Fig. 6. This is a cross section of the turbines being built for the Kearny Station of the Public Service Electric and Gas Corporation, New Jersey, rated at its maximum capability of 145,000 kw at 3600 rpm, with initial steam conditions of 2300 psi, 1100 F, with reheat to 1050 F. The high-pressure turbine has been lengthened to include several stages below the reheat point in order to keep the hottest parts in a single casing and reduce the duty on the intercept valves located on the intermediate casing of the low-pressure turbine. The crossover temperature is about 970 F. Steam strainers are in separate casings in the reheat return lines near the turbine. Blanks may be inserted to permit pressure-testing the reheater. Double-shell construction is used both above and below the reheat point in the high-pressure turbine, and the inner shell is made in three sections dovetailed together. The separate control-valve chest is located in front of and below the front standard, with individual pipes running from each of the six valves to the high-pressure

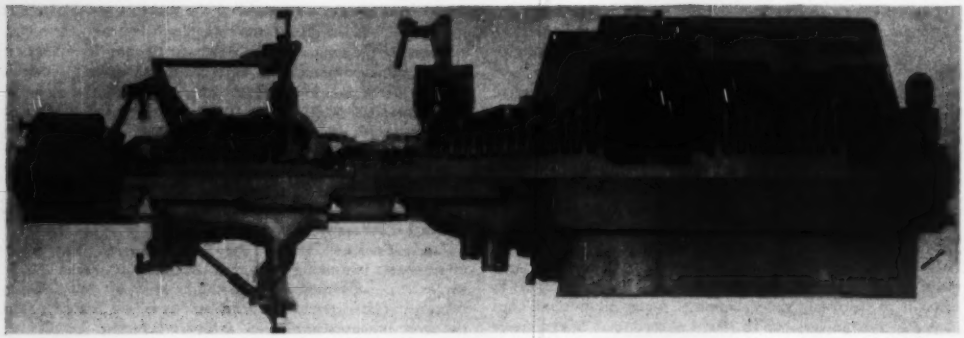


FIG. 5 125,000-KW 3600-RPM TANDEM-COMPOUND TRIPLE-FLOW REHEAT TURBINE FOR 1800 PSI, 1050 F INITIAL AND 1000 F REHEAT TEMPERATURE

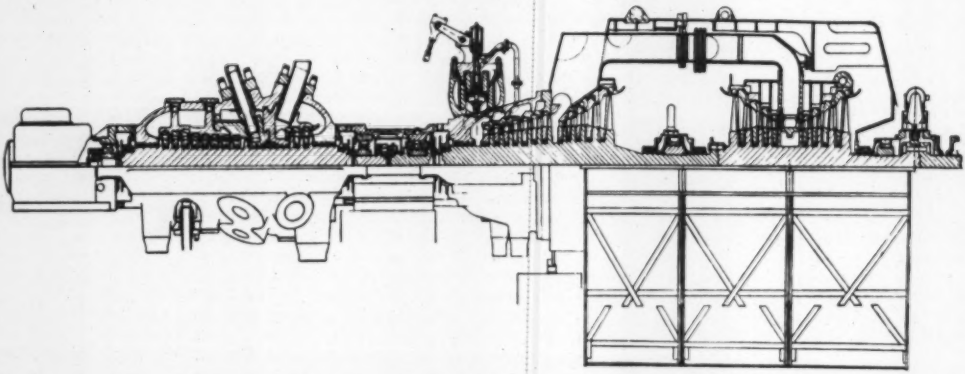


FIG. 6 145,000-KW 3600-RPM TANDEM-COMPOUND TRIPLE-FLOW REHEAT TURBINE FOR 2350 PSI, 1100 F INITIAL AND 1050 F REHEAT TEMPERATURE

casing, two on top and four on the bottom. This chest, as well as the stop-valve body and the center section of the inner shell, all of which contain steam at 1100 F, will be forged austenitic steel; the separation of the valve chest from the turbine casing affords flexibility in design to facilitate forging.

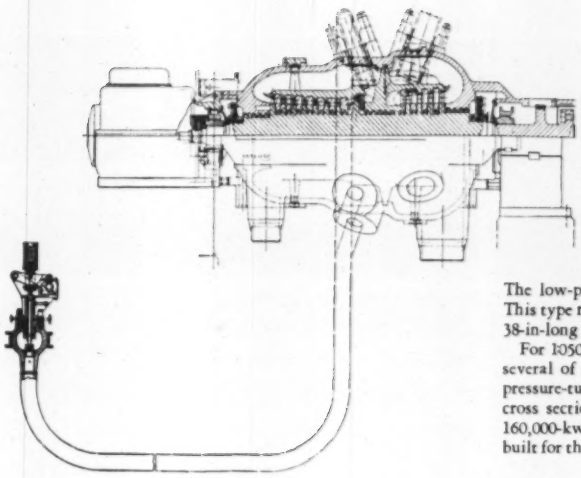
Among the problems of designing for very high temperatures are the bolting of the first-stage nozzle plate to the shell and the centrifugal stresses in the first-stage wheel and buckets. In this design the nozzle plate has been dovetailed into the shell so that no bolts are required. The diameter of the first-stage wheel has been reduced to keep the stresses within allowable limits for ferritic rotor materials at the operating temperature. This results in some loss of economy at light loads but does not affect the full load performance.

Either of these tandem-compound turbines may be provided with a quadruple-flow exhaust similar to that shown in Fig. 8; the additional length required is about 10 ft.

Cross-Compound Turbines. For the largest units, cross-compounding has several advantages over the single-shaft tandem arrangement. The over-all length is less, and the two elements afford greater flexibility in station arrangement. Both turbines and generators can be designed more conservatively and within the limits of past experience. The speed of the high-pressure and low-pressure turbines can be selected more nearly at the optimum; 3600 rpm is inherently advantageous for the high-pressure turbine because it simplifies the problem of designing the shells, rotors, nozzles, bolting, and other parts to withstand very high pressures and temperatures. A speed of 1800 rpm is desirable for the low-pressure turbine where cooling-water temperatures permit high vacuum, since the annulus area of last-stage buckets at 1800 rpm can be made. roughly, 4 times that of 3600-rpm buckets with the same stress level. However, a 3600-rpm low-pressure turbine is smaller and less expensive than the 1800 and may be preferable where vacuum conditions do not warrant the 1800-rpm machine.

On the other hand, the cross-compound arrangement has the disadvantage of higher initial cost and greater complexity of operation, since there are two elements instead of one. The choice between the cross and tandem-compound arrangements will depend on the results of economic evaluation for each particular installation.

The design of the high-pressure turbines of both cross and tandem-compound machines is controlled by the same factors; hence, depending on initial and reheat-steam conditions, the same turbines are used for both types. The division of load between the high and low-pressure turbines may be selected within fairly wide limits of 30 to 60 per cent of the total on the high-pressure. Where reheat is done between the high-



However, the size of the crossover pipes to the low-pressure turbine becomes excessive if too large a portion of the load is carried by the high-pressure.

Typical of cross-compound units for 1000 F reheat temperature and either 1000 or 1050 F initial steam temperature is a machine being built for The Detroit Edison Company rated 125,000 kw with initial steam conditions of 1800 psi, 1000 F, with reheat to 1000 F. The 3600-rpm high-pressure turbine is essentially like the high-pressure section of the tandem-compound machine illustrated in Fig. 5, except turned around so that the control valves are adjacent to the front standard. The low-pressure turbine is similar to that shown in Fig. 1. This type machine can be built in ratings up to 200,000 kw, with 38-in-long buckets in the last stage of the larger sizes.

For 1050 F reheat temperature, it is advantageous to include several of the stages following the reheat point in the high-pressure-turbine casing as illustrated in Fig. 7. This shows cross sections of the high- and low-pressure turbines of the 160,000-kw units (217,000 kw maximum capacity) being built for the Muskingum and Kanawha Stations of the American

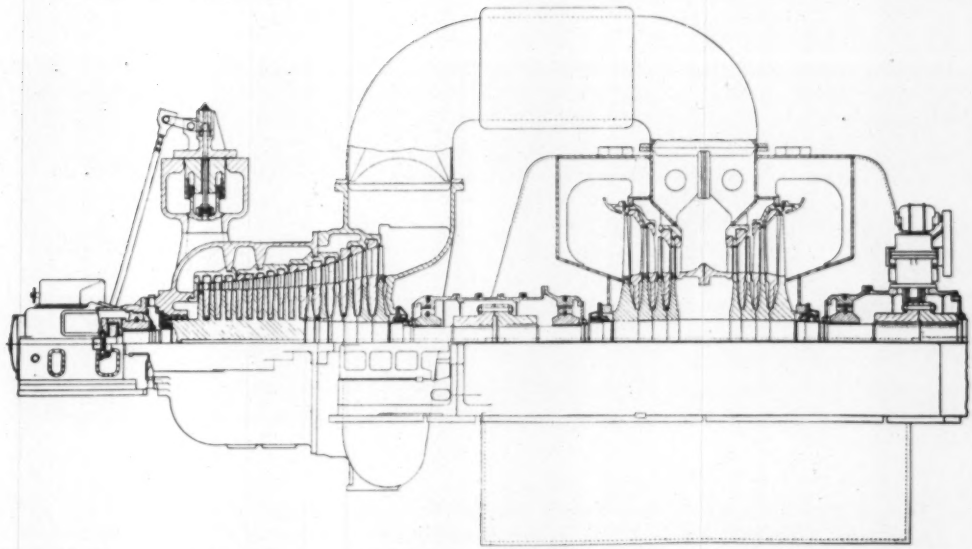


FIG. 7 60,000-KW 3600-RPM HIGH-PRESSURE AND 100,000-KW 1800-RPM TANDEM-COMPOUND DOUBLE-FLOW LOW-PRESSURE TURBINES OF 160,000-KW CROSS-COMPOUND REHEAT TURBINE FOR 2000 PSI, 1050 F INITIAL AND 1050 F REHEAT TEMPERATURE

pressure and low-pressure turbines, the load split is determined largely by the reheat pressure. With reheat pressures in the range usually found best economically, the load split turns out to be 35 to 40 per cent on the high-pressure. The portion of the load carried by the high-pressure turbine can be increased, without changing the reheat pressure, by putting several stages following the reheat point into the high-pressure-turbine casing. Thus the load may be split equally between the two elements, or beyond that, the major portion may be carried by the high-pressure. The consequent reduction in length of the low-pressure turbine and generator may be employed where desirable to obtain minimum over-all length.

Gas and Electric Company for initial steam conditions of 2000 psi, 1050 F, with reheat to 1050 F. The separate control-valve chest, forged from ferritic material, is located in front of the turbine below floor level. There are three stages (although four are shown in Fig. 7) following the reheat point in the high-pressure-turbine casing and delivering steam through crossover pipes to the intermediate section of the low-pressure turbine at 930 F, 270 psi. This favors the design of the intercept valves and intermediate casing. The intercept valves are separately cast vessels welded to the upper half of the intermediate casing. The low-pressure casing and exhaust hood illustrated in Fig. 7 are fabricated. However, the top

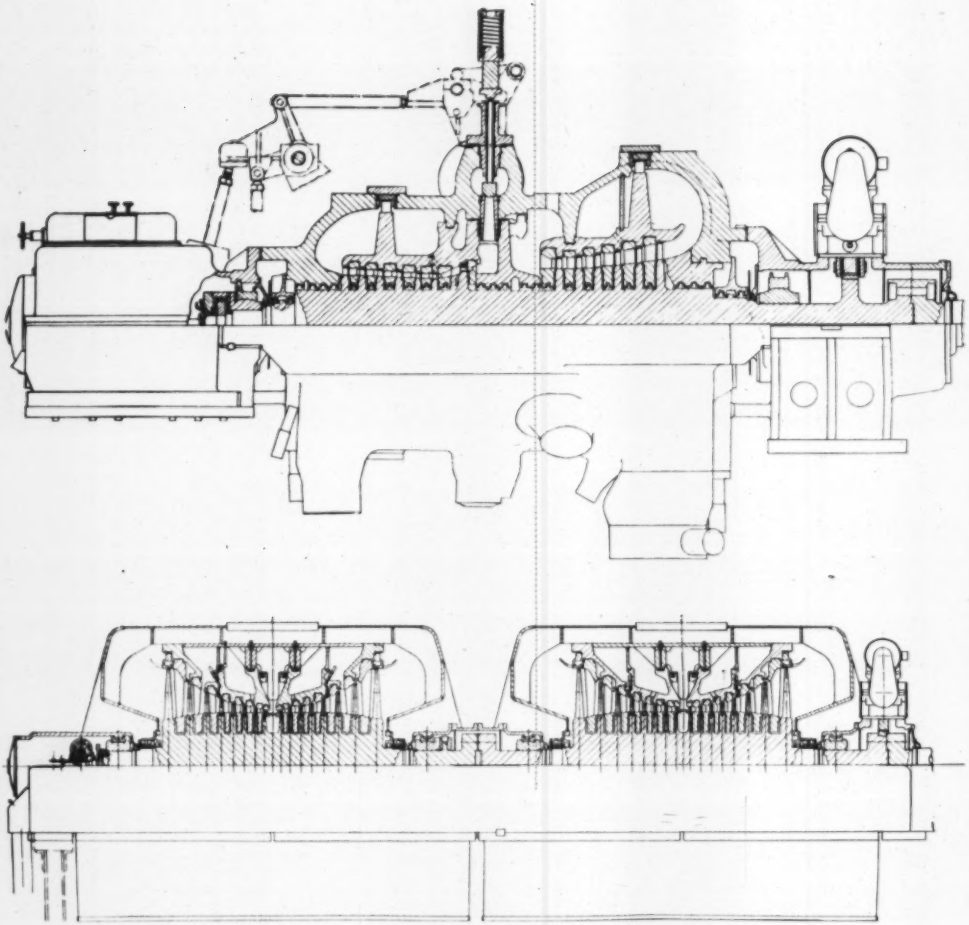


FIG. 8 80,000-KW 3600-RPM HIGH-PRESSURE AND 80,000-KW 3600-RPM TANDEM-COMPOUND QUADRUPLE-FLOW LOW-PRESSURE TURBINES OF 160,000 CROSS-COMPOUND REHEAT TURBINES FOR 1800 PSI, 1000 F INITIAL AND 1000 F REHEAT TEMPERATURE

halves will be cast. Although large low-pressure casings of this type customarily have been made from castings, successful experience with similar fabricated structures on 3600-rpm turbines has indicated the practicability of making the large 1800-rpm casings in the same way. This alternative method of construction opens new sources of supply for such parts and in some respects affords greater flexibility in design.

The 160,000-kw units under construction for the Astoria Station of Consolidated Edison Company of New York for initial steam conditions of 1800 psi, 1000 F, with 1000 F, reheat, are of interest because the load is divided equally between the high and low-pressure turbines, both of which run at 3600 rpm, thus allowing the use of duplicate generators. The cross sections of these turbines are shown in Fig. 8. There are two intercept valves located in the reheat lines, one on each side of the turbine below floor level. The high-pressure turbine contains six stages following the reheat point to obtain the equal load split. Two crossover pipes, each 30 in. diameter and located below floor level, carry steam to the low-pressure turbine at 115 psi 700 F.

CONCLUSION

The performance of 15 reheat turbines placed in service during the past 2 years has been outstandingly successful. Although a few difficulties have been encountered, none of them was fundamental in nature and all have been, or can be, overcome by relatively minor changes in design. With this substantial background of successful experience, the design and manufacture of larger reheat units for still higher pressures and temperatures is being undertaken with confidence.

Design of GRAY-IRON CASTINGS

By T. E. EAGAN

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THE fundamental aim of the foundryman is to produce a casting, with the desired physical properties, which is true to pattern and free from defects. The desired physical properties can be obtained by control of melting and molding procedures by the foundryman. It is not recommended, therefore, that the designer of the casting specify such things as chemical analysis, pouring temperatures, melting charges, and the like, as he usually is not in the best position to prescribe these things. He should specify the required physical properties needed, such as tensile strength, machinability, wear resistance, or any other requirement.

The designer, on the other hand, has the right to demand that his casting be true to pattern and free of injurious defects. Unfortunately, it is not always possible for the foundryman to do this when he is burdened with poor design. There are certain rules of design which should be followed in order to achieve the desired results.

THE FOUNDRYMAN KNOWS BEST

These rules controlling the design of castings are not infallible. It is entirely possible that a casting design could be developed which followed every rule ever propounded which would not yield a good casting. Therefore, the very first rule is for the designer to consult frequently with the foundryman as he designs a given casting. It is surprising what can be accomplished by doing so. The foundryman knows the problems he will encounter in the foundry which are not obvious to the designer. Considerable savings in cost usually can be made by following this approach.

Also, it must be remembered that the old-time molder is an artisan who is proud of his ability to cast any design of casting no matter how complicated or how poorly designed. There are innumerable cases where a great amount of unnecessary work is required which can be attributed to this cause. A classical example of this is the molding of a casting of a cup and saucer with the spoon in the cup.[1]

Modern foundry practice requires that the art of molding be changed to the science of molding in order efficiently and economically to produce castings. However, there are numerous foundrymen still at work who are willing to tackle any job. Therefore it becomes a matter of necessity that designers take heed of this condition and know the foundry and foundrymen with whom he is dealing.

Conversely, the designer should be willing to change his design to conform to good foundry practice so long as its intended functional qualities are not impaired. The very fact that the designer willingly consults with the foundryman precludes much trouble in this respect.

[1] "The Cup, Saucer, and Spoon," by Pat Dwyer, *Foundry*, vol. 79, May, 1951, pp. 106–109.

Contributed by the Metals Engineering and Production Engineering Divisions and presented at the Annual Meeting, Atlantic City, N. J., November 25–30, 1951, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

ITEMS TO CHECK WITH THE FOUNDRYMAN

Some of the things which should be checked with the foundryman are as follows:

1 General design of the casting.
2 How the casting is to be molded.
3 Location of the parting line.
4 Accessibility for any enclosed spaces for cleaning.
5 Dimensional limits that must be held.

In cases where a great number of castings of one design are to be made, or where a considerable expense is involved in making the patterns, or where the design is very intricate, it is advisable to have a scale or full-size model made. By doing this many troubles which could be foreseen by no other method can be avoided. An example of such a model is shown in Fig. 1.

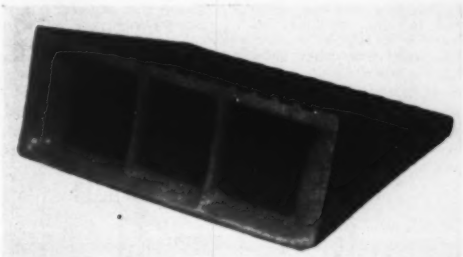

FIG. 1 EXAMPLE OF WOODEN MODEL MADE OF A COMPLICATED CASTING TO HELP FOUNDRYMEN AND DESIGNERS DECIDE ON METHODS OF MOLDING

Over a period of years a set of general rules which govern good casting design has been developed and published a number of times, some of these are quite comprehensive.[2,3,4,5] However, the book "Engineering Properties of Cast Iron"[2] presents an excellent section on design, and it is from this book that the examples shown in Figs. 2 to 11, inclusive, are taken.

PRACTICAL SUGGESTIONS

Castings should have sections which are no thicker than necessary to meet the required stress imposed on them. This

[2] "Engineering Properties of Cast Iron," American Foundrymen's Society, 1950.

[3] "Cast Metals Handbook," third edition, American Foundrymen's Society, 1944.

[4] "How Design Is Affected by Foundry Practice," by O. Smalley, *Product Engineering*, vol. 21, February, 1950, pp. 117–121.

[5] "Fundamentals of Casting Design," by O. Smalley, Bulletin, Meehanite Metal Corporation.

FIG. 2 INCORRECT AND CORRECT DESIGN OF BOSSES OR PADS

(Bosses or pads which increase metal thickness of thin walls, or thick sections surrounding thin sections, should have section blended gradually into body of casting by tapering or flattening fillets in order to avoid localized "hot spots.")

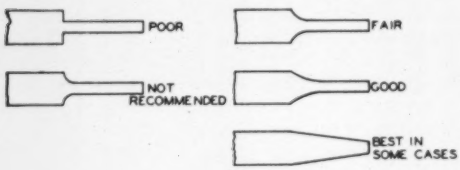

FIG. 3 PROPER USE OF FILLETS AND TAPER

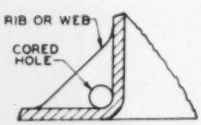

FIG. 4 WEB AND RIB DESIGN

(Avoid concentration of metal by providing cored openings in webs and ribs. Such openings should be as large as possible, consistent with strength and stiffness.)

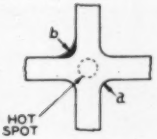

FIG. 5 CROSSING MEMBER

(The crossing of members increases mass of metal at *a*, the crossing point, and will retard cooling of metal at that point. This is aggravated by too-large fillets, *b*.)

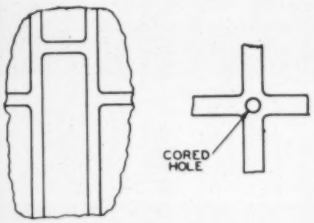

FIG. 6 STAGGERING RIBS OR WEBS

(Avoid concentration of metal by staggering ribs or webs. Use of cored hole where ribs must cross will eliminate hot spots.)

FIG. 7 CIRCULAR WEB

(A circular web with ribs extending from its periphery is an excellent design on large flat plates. In this case, section of circular web may be less than section of ribs.)

FIG. 8 (*right*) THIN RIB

(Thin ribs should be avoided when joined to a heavier section. Thin ribs will freeze first and pull away from heavy section. Ribs do little good in tension and should be used in compression only. Thickness of rib should be 0.8–0.9 of casting thickness.)

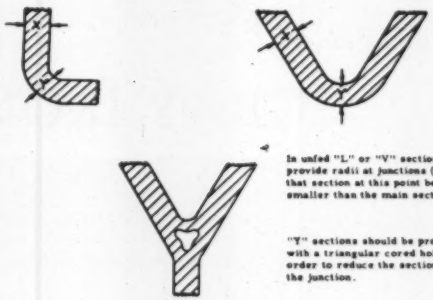
In unfed "L" or "V" sections, provide radii at junctions (y) so that section at this point becomes smaller than the main section (x)
"Y" sections should be provided with a triangular cored hole in order to reduce the section at the junction.

FIG. 9 L, V, AND Y-SECTIONS

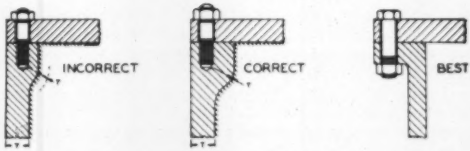

FIG. 10 INCORRECT AND CORRECT WAYS OF INSERTING STUDS

(An inserted stud cannot restore the effectiveness of original metal section. Therefore, wall section adjacent to drilled holes should be equivalent to main body of casting. Pressure on shaded side.)

FIG. 11 CORED HOLES IN RIBS OR WEBS

(Avoid cored holes of rectangular shape in ribs or webs. Used cored holes of oval shape with longest dimension in direction of stress.)

is logical because the physical properties obtained are based upon the section thickness. On the other hand, the section thickness must not be so thin that the metal will not run through it. This latter condition can best be set by the foundryman who must gate the casting to allow the proper flow of metal.

All sharp angles should be avoided. Use gentle contours wherever possible. Proper radii should be used in all cases. Too-large a radius is just as bad as a too-small one. In order to avoid stress concentration, the fillet radius should be equal to twice the thickness; however, a fillet radius of $\frac{1}{3}$ or $\frac{1}{2}$ the thickness is better for soundness in the castings. Therefore some compromise usually must be made with the foundryman. Some suggestions of what to do are shown in Figs. 3 and 4. Bring together the minimum possible number of sections. A much better practice is to stagger the junctions as shown in Figs. 5 and 6.

Design castings with a uniform section thickness (see Fig. 2). Where this is impossible blend the sections together instead of making abrupt connections, as shown in Fig. 3. However, because the inner walls cool more slowly than the outer walls, they should be 0.7 to 0.9 of the outer-wall thickness, depending upon the intricacy of the pattern.

Always reconsider large complicated castings to see if the same results could be obtained by joining several less complicated sections together.

Ribs should be employed, but only where they will help in reducing the weight or warpage of the casting. Be careful to determine if they interfere with molding. They should have a thickness approximately 0.8 the casting thickness and should be properly filleted and rounded. Sometimes ribs can be eliminated entirely by designing a bulge in the section instead of a rib. They are effective in compression, but not so in tension. There is a tendency for designers to add more ribs than necessary to a casting. Many of these do not function, yet they add to the cost and, in many cases, interfere with proper molding, often leading to a greater number of rejects.

Always design castings to have straight parting lines. Irregular parting lines require much more difficult molding procedures.

A draft must be provided for removal of the pattern from the sand; this usually averages $^1/_{16}$ in. per ft. However, more draft is necessary for hand molding than for machine molding; interior draft should be greater than exterior; in deep draws less draft is usually used.

Avoid the use of cores to as great an extent as possible. Design to have the pattern leave its own core if it is feasible. When separate dry-sand cores are used, design so that adequate core prints can be used. In the case of pressure-tight castings avoid the use of chaplets.

Where cores are used, be sure to provide for adequate clean-out holes. If possible these holes should be located out of the highly stressed areas.

SHRINKAGE RULES AND MACHINING ALLOWANCES

Gray iron like most metals shrinks when it solidifies. This shrinkage is not uniform for all classes of iron. However, provision must be made for this by the use of shrinkage rules, which for cast iron may be $^1/_{16}$ to $^5/_{32}$ in. per ft, depending upon the grade of gray iron and the size of the pattern. The patternmaker will know what shrink rule to use.

TABLE 1 TYPICAL MACHINE FINISH ALLOWANCES

(In addition to shrinkage allowance)

Dimension of casting, in.	Expected tolerances for "as-cast" dimension, in.
Up to 8	± $^1/_{16}$
Up to 14	± $^3/_{32}$
Up to 18	± $^1/_8$
Up to 24	± $^5/_{32}$
Up to 30	± $^3/_{16}$
Up to 36	± $^1/_4$

The amount of machine finish allowance varies with the analysis of the metal used, the design of the casting, and its size, the tendency to warp, and the machining methods used. Table 1 shows typical finish allowances for general gray-iron castings. In the case of cylinders, special allowances must be made, and the foundry should be contacted to determine these.

It is desirable that an agreement be made with the producing foundry on the machining allowances required. Then these allowances should be indicated on the drawing. This acts as a guide to the foundryman for the choice of pattern material, methods of molding, and the time at which the pattern needs repair or replacement. In large castings many foundrymen may use certain surfaces as dirt traps which require rather heavy finish allowances. It should be determined if such practice can be tolerated economically.

A great many castings are made with machine reference or locating pads which are usually ground to the proper dimensions by the foundry. These, of course, should be marked clearly on the drawing, and the dimension limits clearly indicated.

Permanent-mold and castings made by other specialized casting processes, require special machining allowances. As these usually have particular requirements, the foundry which is going to make the castings should be contacted.

TREATMENT FOR INTERNAL STRESSES

Most gray-iron castings have some internal stresses in them which may cause warping during machining. The higher-strength irons usually have the highest internal stress. Unless these stresses are deliberately put into the casting for strengthening purposes they should be removed by a stress-relief anneal. A rather complete discussion of stress relief is given in the book, "Engineering Properties of Cast Iron."[2]

It is not sufficient to call for a stress-relief anneal, because there are many erroneous ideas as to what constitutes a proper stress-relief-annealing treatment. On this subject no standard of recommended practices has been issued by the various technical societies. Therefore it is necessary that the annealing cycle be indicated either by a special specification or noted on the drawing. As a guide the following rules are used by the author's company:

1 Heat castings slowly and evenly at a rate not to exceed 50 F per hr to 1050 F.

2 Hold at 1050 F for 1 hr per in. of heaviest section.

3 Cool at a rate of not more than 400 F per hr until a temperature of 500 F is reached, then air-cool.

It is well to discuss briefly some of the erroneous ideas about stress-relieving gray iron. Schaum[6] has shown that no relief of stress occurs in castings by storing them for $1^1/_2$ years outdoors, yet this practice is still used. Alternate heating to 220 F and then cooling to 0 F does not remove stress. Etching the surface shows a small amount of stress relief but not enough to be of any consequence. Schaum also has shown that it takes many, many hours to relieve stresses at temperatures below 950 F, yet some foundries use temperatures as low as 500 F. There is only one good way of relieving stress and that is to follow a similar procedure to that recommended in the foregoing.

STRESS ANALYSIS OF CASTINGS

Great progress in design work has been made in the last few years by the use of the various methods of stress analysis. Where the cost is warranted this is the best method of getting a properly designed casting. The use of the newer stress-analysis tools has served to change the design of many castings. Also they have been influential in changing our thinking on the calculation of stresses. The ASTM "Symposium on Testing of Cast Iron With SR4 Type of Gage"[7] gives a number of illustrations of the use of these tools and their effect on design.

CONCLUSION

A casting will be no better than its design allows the foundry to make it. There are more gray-iron castings which have been overdesigned than there are which have been properly designed. This is due mainly to the fact that designers have not been cognizant of the characteristics of the modern gray irons and, therefore, have not used them properly. Hence it is recommended that the designers become more familiar with the engineering properties of gray iron and use them to the best advantage.

[6] "Stress Relief of Gray Cast Iron," by J. H. Schaum, Trans. AFS, vol. 56, 1948, pp. 265–277.

[7] ASTM Special Technical Publication No. 97, June, 1949.

A $65 QUESTION: WHAT'S IT LIKE IN "HEAVEN"?[1]

By GEORGE B. BALDWIN

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

GOALS and Strategy in Collective Bargaining"[2] is one of the first attempts to spell out what we mean when we talk about "good labor relations." Harbison and Coleman[3] pick up this slippery question just where most of the rest of us put it down: They begin from a suspicion that "peace, survival, and harmony are false criteria for constructive relations in a dynamic society." They end up by proposing a set of different criteria which harmonize more happily with the untidy vitality of American life. And in between their initial query and their final (but tentative) answer they provide us with a systematic review of the main kinds of union-management relations that have grown up in the mass-production industries during the past 15 years.

The authors begin by reviewing certain developments which have made clearer what collective bargaining consists of than was foreseeable when "organization" was in high gear a decade or so ago. Today's strikes, for example, are more orderly tests of strength than they used to be. Employers, rid of their first fears, have become less emotional in their approach to unions. Union members have not come to regard their unions as instruments of the class struggle but as "service" organizations whose main job is to "police" managerial policies and actions. And within the unions, power has tended to settle down in the hands of full-time officers, with the rank and file playing a relatively passive role. These developments mean that union-management relations have become relationships between two kinds of *institutions*, institutions whose conflicting interests must somehow be accommodated to each other. This "accommodation process" involves influences different from those involved in "management-employee" relations, since union-management contacts center on the interactions of leaders, of representatives, of agents—not of "principals." The whole process of collective bargaining, therefore, becomes a method of arriving at (and later enforcing) a "treaty" which will define "a power relationship between interests." Though the authors do not press the analogy, union-management relations are more like international relations between rival nations than anything else.

Since collective bargaining involves mainly a relationship among leaders, it becomes necessary to analyze the complex social, economic, political, and psychological forces which are at work on union and management representatives, influencing the treaty-making process and its outcome. Harbison and Coleman spell out five broad objectives which most managements seek in negotiations and a like number which motivate union representatives. While the two sets of objectives are broadly similar (and hence often in conflict), the authors point out that collective bargaining is only one of many vital problem areas to which management must give daily attention, while in the union's case, collective bargaining is a much more exclusive concern.

Against this perspective, Harbison and Coleman proceed to classify the different types of relationships which exist in the mass-production industries. On the basis of an examination of some 100 specific situations during 1948–1950, they set up three "models" or types of relationships which represent "clustering points" along a continuum of individual situations. They give these models the names (1) "armed truce," (2) "working harmony," and (3) "union-management co-operation." Separate chapters are devoted to a description of the different controlling attitudes and external characteristics of each of these three general types. The authors then go on to suggest several reasons ("environmental" and "internal") why one type of relationship develops in one case and another type elsewhere.

The most harmonious and co-operative relationships, for example, are typically found where the company is faced with very severe business competition—usually so severe that the company's existence (and the local union's as well) is at stake. Under the stress of a clearly perceived external threat, both union and management feel more dependent upon the co-operation of the other party. Profitable companies, however, have less inducement to cultivate the union's co-operation—and the union's appetite is whetted by the company's success. A second crucial environmental factor is the strategic importance of the negotiations with respect to the industry in which the parties operate. In the "power centers," where the "key bargains" are hammered out (e.g., in the steelworkers' negotiations with U. S. Steel), the union has much more at stake than just the outcome of the particular negotiations in hand. Once the key bargain is made, there is usually a tacit understanding during later negotiations in the passive satellite centers that these later agreements will be patterned closely on the pacesetter. Thus Harbison and Coleman found that "armed truce" characterized *all* the key-bargain situations they studied, while it characterized only about a third of the pattern-following relationships. Other environmental factors of less importance are the general climate of public opinion, the legal framework of negotiations, and the size and population-characteristics of the communities in which firms operate.

Among the "internal" factors influencing the relationship, the authors mention the length of time collective bargaining has taken place between the parties, the size of the firm (the larger the firm, the less the likelihood of achieving "working harmony"), and the caliber and skill of the chief negotiators (though they think the role of individuals is easily exaggerated).

The most suggestive chapter in the book is the final one, "A

(*Continued on page 139*)

[1] One of a series of reviews of current economic literature affecting engineering, prepared by members of the Department of Economics and Social Science, Massashusetts Institute of Technology, at the request of the Management Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Opinions expressed are those of the reviewer.

[2] By Frederick H. Harbison and John R. Coleman, published by Harper and Bros. for the Industrial Relations Center of the University of Chicago. New York, 1951, 172 pp., $2.50.

[3] Professor Harbison is professor of industrial relations and executive officer of the Industrial Relations Center at the University of Chicago; Professor Coleman is a former research associate in the Chicago Industrial Relations Center and is now assistant professor of industrial relations at the Massachusetts Institute of Technology.

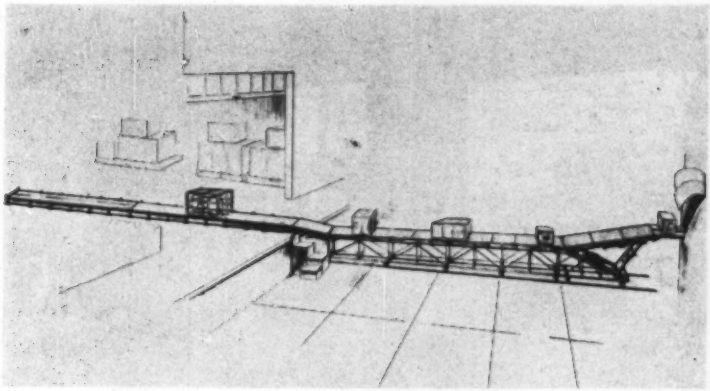

FIG. 1 SKETCH OF AIR CARGO LOADING CONVEYER

AIR FREIGHT HANDLING
at Kelly Air Force Base

By IVAN E. CAMPBELL

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MECHANIZED HANDLING PROCEDURES

RECENTLY developed mechanical devices installed at Kelly Air Force Base include a powered conveyer for moving cargo between the air-terminal warehouse and an airplane, a unique type of dolly for moving cargo across the floor of an airplane, and the adaptation of conventional roller conveyers on the floors of trucks to expedite handling of cargo between storage warehouses and the air terminal.

The most important of these developments to date, and the one which by its very nature has brought about subsequent improvements, is the powered conveyer extending from the center of the air-terminal warehouse floor to the door of the aircraft. This conveyer is capable of carrying items varying in weight from a few ounces to 1000 lb. It has an elevation adjustment which permits its use with most of the types of cargo aircraft in use in the Air Force at this time. This includes the C-46, C-47, C-54, C-82, and C-97 type aircraft. The present model is limited to a 21-deg angle of incline which provides delivery of cargo at a height of 10 ft above the ground. It is reversible to provide for both loading and unloading. Aircraft are moved into position for conveyer handling by towing. The location of the aircraft is indicated by a painted stripe and block for the inside landing-gear wheel of each of the various types of aircraft handled.

This mechanization of air cargo handling created bottlenecks at both ends of the conveyer. New and faster methods of checking freight had to be developed. Prior to mechanization the checking of freight, both inbound and outbound, was accomplished in the airplane as the items passed through the aircraft door. It was found that this job regulated the speed with which cargo could be handled by the conveyer and that the ground handling time for the airplane was determined by the rate at which checking could be accomplished. This procedure was changed to provide for checking outbound cargo in the warehouse prior to arrival of the aircraft and placement of items on the conveyer system. Inbound cargo also is checked at the conveyer line inside the warehouse. Thus the checking operation is accomplished before the loading and after the unloading operation.

Improved methods of handling, in the aircraft, in the air terminal, and between the terminal and warehouses, were essential to keep the freight moving at the pace set by the powered conveyer. Because of the many different types of aircraft involved, and the variety of sizes, shapes, and weights of pieces of freight handled, no single device as yet has been developed for moving cargo between the end of the conveyer and the stowage location within the aircraft. However, the time and manpower required to perform this operation manually have been reduced considerably by the use of lightweight sections of roller-skate-wheel type conveyer laid on the floor of the aircraft or, for heavy and bulky items, by the use of locally manufactured roller wheeled dollies. The rollers, being 24 in. long, distribute the weight over sufficient area of the floor to prevent damage such as results from the use of conventional narrow wheel-type dollies.

Ease and speed of movement of freight on and off the warehouse end of the powered conveyer is provided by a conventional roller-type conveyer. This is laid level with and as a prolongation of the powered conveyer and provides space for

Contributed by the Aviation and Materials Handling Divisions and presented at the Annual Meeting, Atlantic City, N. J., November 25-30, 1951, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

FIG. 2 INBOARD SECTION OF CONVEYER

setting up and checking outbound freight. When an aircraft is in position for loading, freight prechecked and stacked on this section can be fed onto the powered section by one man at any rate and in any order desired. Freight being unloaded is pushed onto this roller section automatically by the powered section. This inbound freight is palletized and checked against the air manifest as it is removed from the roller section of conveyer for movement to the warehouse. Pallets are then moved by fork-lift truck and loaded onto flat-bed trailer trucks, 25 or 40 ft long, for movement to storage warehouses. Lightweight woven-wire baskets approximately 18 in. wide × 30 in. long × 6 in. deep are used to carry small items along the conveyer system to reduce handling and insure passage from section to section.

A plan for further mechanization of this operation, to eliminate handling by fork lift, has been completed but has not been implemented to date. Under this plan the section of roller-type conveyer will be extended out the rear side of the terminal warehouse to the edge of the truck-loading dock. Flat-bed trucks 25 ft in length, equipped with sections of the same type conveyer, will be backed into position so that the conveyer on the floor of the truck forms a level extension of the conveyer on the dock. Empty pallets will be placed on this section by hand. As they are filled they easily can be pushed to the dock for loading. No fork-lift handling will be required. A complete trailer load can be loaded in one simple operation in about 2 to 3 min by one man pushing the entire string of pallets along the conveyer. Trucks and docks equipped with such conveyers are presently in extensive use for the movement of material between shipping, receiving and storage warehouses on the base and have proved extremely valuable as time and labor-saving devices.

DESCRIPTION OF MECHANICAL DEVICES

Powered Conveyer. The powered conveyer consists of three main sections and one short connecting section. For the purpose of this description these sections will be referred to as follows:

"Inboard section" is that part which extends from the center of the warehouse floor to the edge of the dock.

"Center section" is that part which extends from the edge of the dock to the outboard section.

"Outboard section" is that part which extends from the center section to the airplane.

"Connecting section" is that part between the inboard and center sections.

The inboard section is installed in the warehouse floor. It consists of a belt 46 in. wide installed over sections of conventional roller-type conveyer with 6-in. steel drums for pulleys at each end. One of these drums is driven by a link-type chain connected to a 3-hp reversible electric motor. The upper surface of the belt is 12 in. above the level of the warehouse floor. This section is 41 ft long and covers a tunnel in the warehouse floor into which the center section retracts.

The connecting section is a short inclined section designed to transfer freight between the inboard and center sections which are at different levels, the inboard section being 17 in. higher than the center section. This connecting section is 6 ft long and is of the same general construction as the inboard section. Power for this section is obtained by use of a chain-and-sprocket connection with the adjacent inboard section.

The center section is 45 ft long. It is made of 2-in. angle-iron framework, mounted on grooved wheels which ride on steel tracks bolted to the concrete ramp. The conveyer way of this section consists of hardwood slats attached to standard link-type conveyer chains. Power is supplied by a 3-hp reversible electric motor through a series of reduction gears and chain driving a sprocket wheel. This section retracts into a tunnel in the warehouse floor. The retracting and extending device consists of another chain-and-sprocket arrangement, driven by a 3-hp reversible electric motor. This feature permits retraction of the conveyer to prevent interference when aircraft are moved to or from the loading spot. Control of the retracting mechanism is provided by a conventional three-position switch located on the side of the dock adjacent to the tunnel. Limit switches also are provided on the conveyer track to prevent the possibility of overtravel of the conveyer during extension or retraction. These switches are operated by an arm protruding from the frame at each end of the center section.

The outboard section is 16 ft long. It is provided with an elevation adjustment which permits cargo to be delivered to the floor of any airplane which is not over 10 ft above the surface of the ramp. This section was made from a standard carloading conveyer. It is of the same general construction as the center section but was modified to provide an undercarriage with wheels to fit the conveyer track. The conveyer way consists of hardwood slats like the center section except that every other one is rubber covered to prevent slippage of freight when oper-

ated at a steep angle. Power for operation of this section is transmitted from the center section through a chain and sprocket. The frameworks of the center and outboard sections are connected at the bottom by means of turnbuckle-type bolts and nuts which provide adjustment for space between these sections and for proper tension on the drive chain. The outer end of the outboard section is equipped with a 3-ft section of conventional roller conveyer. This section is hinged to the end of the powered section and extends into the aircraft. It is fitted with a quickly adjustable jack-type leg at each outboard corner to provide level supports at proper height from the aircraft floor.

For unloading, the end inside the aircraft is set slightly higher than the end of the powered section of the conveyer so that pieces of freight can slide easily down onto the powered section. For loading, the end is set lower than the end of the powered conveyer. This piece of conveyer is to be replaced in the near future with a stainless-steel chute which will be lighter and easier to handle than the present installation. The elevating mechanism is operated by a series of cables and pulleys. The cables are wound on drums driven by a 1-hp reversible electric motor. Manual operation, in case of motor failure, is provided by means of a hand crank connected to the drums by a series of gears. Control of the elevation adjustment is provided by means of a three-position switch located on the side of the outboard-section framework.

Electric power is supplied to the traversing sections by means of a rubber-covered cable which extends from an automatic rewind reel with conventional ring and brush contacts.

Control of the entire conveyer way is provided by a portable three-position switch box which can be carried onto the dock or into the airplane by the operator. The connecting cable is hung in loose coils on the side of the conveyer frame at present, but eventually will be contained on an automatic rewind reel equipped with conventional ring-and-brush contacts.

Roller-Wheeled Dolly. Dollies are manufactured locally by cutting 24-in-wide conventional roller conveyer into 3 or 4-ft lengths. Reinforcing, in the form of crossbars of angle iron or, for extremely heavy duty $^1/_4$-in. solid steel plate is welded to the bottom. A hinged towing handle is attached to one end. When placed with the rollers down on smooth surfaces, such as warehouse or airplane floors, loads up to 5000 lb can be moved with very little effort. This type dolly, used in pairs to provide one under each skid, is also used to move aircraft engines, weighing as much as 7500 lb, over the floor of an aircraft.

LIMITATIONS OF THE CONVEYER

Handling of cargo inside the airplane continues to be the factor which limits the speed with which an airplane can be loaded or unloaded. Although conveyers and dollies, as previously described, are improvements over a strictly manual operation, the physical handling involved in stowing outbound cargo and breaking out inbound cargo cannot, or at least has not to date, been eliminated. It is this handling that limits the speed with which air cargo can be transferred from airplane to terminal and vice versa. However, the steady pace of the conveyer pouring cargo into or from an airplane forces the handling crew to work at a faster pace.

The powered conveyer will operate in one position only in so far as the distance from the terminal is concerned. Also, since it rides on fixed rails there is no lateral adjustment. Therefore aircraft must be parked within a distance of only a few inches of predetermined and marked locations. This tolerance is so small that it precludes taxiing of aircraft into position. Aircraft are moved into position for loading by towing which requires several minutes, depending on the distance of the parked plane from the terminal and the skill of the tow operator.

The limitation as to the maximum height cargo can be delivered by the powered conveyer is the angle of incline of the elevating outboard section. Since this section is only 16 ft long and the lower or inboard end is hinged at a point 4 ft above the ramp surface, the conveyer way must be set at a 21-deg angle of incline to reach the cargo floor of the C-97 aircraft which is 10 ft above the ramp. This has been found to be the steepest angle practical. At any steeper angle, cargo will tumble at the base of the incline. Even at a 21-deg angle, certain items, such as square boxes, will tumble occasionally. This can be overcome to a considerable extent by placing another piece of freight immediately behind the square piece as it is loaded on the conveyer. This limitation can be overcome by increasing the length of the outboard section.

CONVENTIONAL HANDLING PROCEDURE

The mechanized procedure described in the foregoing is employed in the handling of all cargo of reasonable size, shape, and weight, except when loading types of aircraft having cargo floors too high to reach with the elevating section of the conveyer, such as the C-74 and C-124, or aircraft with loading doors in the bottom of the fuselage, such as the XC-99. Such aircraft are loaded in conventional manner by use of pallets and fork lifts. Freight is moved from the terminal to aircraft on 4-ft

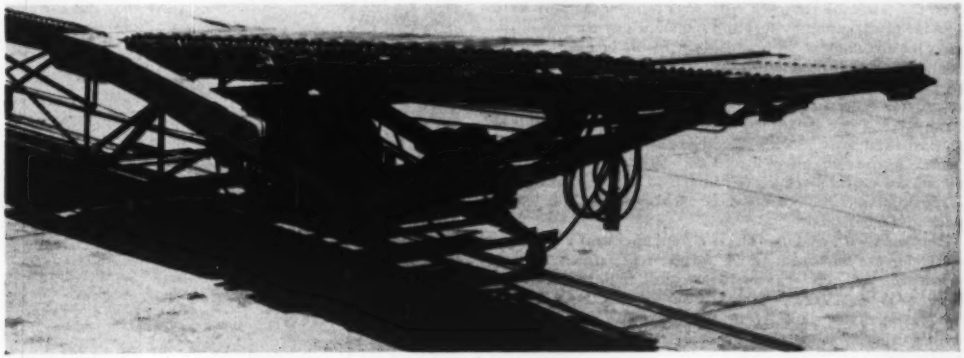

FIG. 3 OUTBOARD SECTION OF CONVEYER

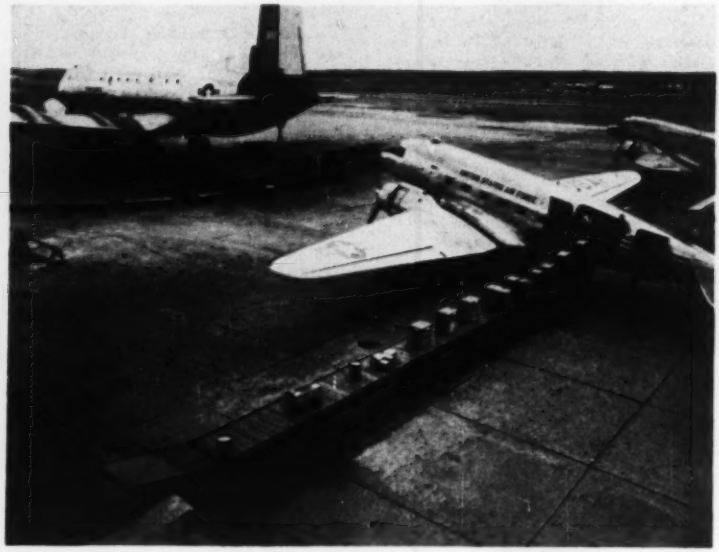

FIG. 4 CONVENTIONAL AND CONVEYER LOADING METHODS

× 12-ft flatbed trailers. Such items as small aircraft, helicopters, the largest of aircraft engines, and many other large and bulky items are loaded by any combination of devices available, such as hoists installed in aircraft, plane-loader-type fork lifts, and manpower. Occasionally items such as large aircraft surfaces weighing from 1000 to 3000 lb must be handled solely by manpower since the size necessitates loading without crates or cribbing which precludes the use of hoists or fork lifts.

NEW DEVICES UNDER DEVELOPMENT

Portable Cargo Containers. The construction of large portable containers for use with the XC-99 airplane is presently in progress. These containers are 7 ft long, $6^1/_2$ ft wide, and as high as the top of the cargo compartments will permit. This varies from $4^1/_2$ to $5^1/_2$ ft. The containers have a capacity of 4000 to 5000 lb. They are equipped with steel rails on the bottom to provide for handling by fork lift and slots near the top of the sides for attaching an adjustable hoist lifting bracket. Empty containers weigh from 310 to 350 lb each. For experimental purposes the containers are being made in sufficient quantity to provide at least three complete sets, one set at each of two terminals and one aboard the aircraft. Each container will be marked to identify it with the cargo compartment of the airplane. As the container is loaded with freight, the weight will be marked on the outside. Upon arrival of the airplane the loaded containers on board will be exchanged for those loaded with outbound cargo.

Modification of Fork Lift. The C-97 type aircraft is used extensively for the movement of the largest-type aircraft engines. When packed in cans for overseas movement, these engines weigh from 6800 to 7500 lb. Hoists installed in these aircraft have a maximum capacity of 5000 lb. Standard fork lifts with a capacity sufficient to lift these engines are too high to pass under the tail of the plane. At present a combination of small fork lift and airplane cargo hoist is used for loading these engines and other heavy items, but this is a slow and hazardous procedure. To improve this operation, engineering plans have been completed for modification of a 14,000-lb-capacity plane-loader fork lift so that it will operate safely under the tail of the airplane, yet retain its lifting capacity for a height of 10 ft. The modification will consist of reducing the height of the lifting boom. It is estimated that the loading time per engine will be reduced 60 to 75 per cent.

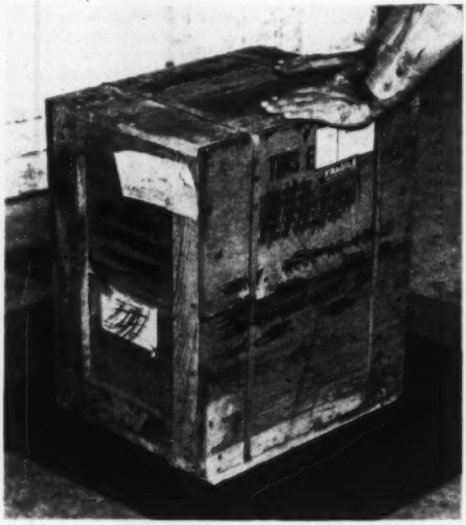

FIG. 5 THE ROLLER-WHEELED DOLLY

INDUSTRY *and* THE ATOM

By T. KEITH GLENNAN

COMMISSIONER, UNITED STATES ATOMIC ENERGY COMMISSION, WASHINGTON, D. C.

PRESIDENT-ON-LEAVE, CASE INSTITUTE OF TECHNOLOGY, CLEVELAND, OHIO

THERE are several reasons why we in the Atomic Energy Commission welcome an opportunity periodically to discuss our problems with The American Society of Mechanical Engineers.

As a group, mechanical engineers, using the ASME as their vehicle for expression, have taken an active and constructive role in developing our national atomic program. Senator Brien McMahon, now chairman of the Joint Congressional Committee on Atomic Energy, came to you for advice back in 1946 during the debate on the bill that today is the basic law governing AEC operations. Our first chairman, David E. Lilienthal, addressed your Annual Meeting in 1947. Two years later the ASME made some thoughtful proposals for more effective participation by industry in the activities of the AEC. These plans produced concrete results, though they were not adopted in toto.

Your request that a member of the Commission address you at this meeting is evidence of your continuing interest. As we contemplate the possibility of still another increase in our atomic-energy production program, we stand in need, once more, of your interest and thoughtful counsel, both as individuals and as members of a great engineering and management group.

One of the reasons for this is the fact that probably the most striking aspect of engineering today is the steady movement of members of the profession into the management of industry. This is particularly noticeable in the atom business. We consider the AEC to be primarily an industrial operation and this development is certainly evident to anyone who takes the time to examine it. Our general manager and the deputy and assistant general managers are engineers. Each of the ten managers of operating field offices is an engineer. Two of the five Commissioners were trained as engineers. Thus the engineering viewpoint and approach bulk large in two ways: in the making of AEC policy and in the day-to-day supervision of atomic-energy operations.

The basic operating principle of the AEC is to accomplish its production goals through the genius of American industry. As the engineer assumes an increasingly more important role in the leadership of both industry and the atomic-energy program, it seems worth while, then, to discuss with you—as engineers, managers, and professional men—some aspects of the present and future role of industry and business in this great new activity. My own concern about the overlong continuation of the present governmentally dominated industrial-governmental relationship for the prosecution of the atomic program makes this opportunity for discussion with you particularly attractive to me.

Perhaps we can best get into this by asking some questions and then suggesting answers that may stimulate further study and debate on this subject in your local chapters as you return to your home cities. Some appropriate questions, I would say, could be:

1 How did the AEC get its present contractors?

2 What are the handicaps of working in the atomic program?

3 What are the incentives?

4 What is the AEC doing to help industry and management to understand the atom business?

5 What should be the role of private industrial enterprise in the future of a rapidly growing government enterprise—an enterprise which takes on many of the aspects of a monopoly created by law—an enterprise upon which much of the future security and well-being of this nation may substantially depend?

Most of the distinguished names in American industry are to be found on the roster of prime contractors of the AEC. Many of the 500 major contractors are represented in this audience. As a group, these firms make up a substantial segment of the top industrial organizations in America. And more companies are coming in as the program expands. How, then, did these firms get into this business and why are they working for the government?

I would not presume to try to answer for each of these industrial contractors. However, I have made it a point to raise the question with several of those who have been in it for a long period of time; and to raise the question also with the General Manager, the operating managers at the field offices, and with the directors of program divisions at headquarters. It is important to have the answers to this question for there is every evidence that the dedication of the managerial skill, the operating competence, and the cost-cutting know-how of industrial contractors large and small has played a major part in making this nation's atomic program as successful as it has been. If the atom business is to thrive and prosper on a prospectively broader scale, the nation must command more rather than less of such dedication and service on the part of industry.

In brief, the responses to my inquiries have indicated that two motives have dominated the decisions of industrial management to accept the uncertainties of Federal service in the atomic-energy program—and both of these motives continue to satisfy the newcomer to the business today. The first was expressed rather well by Dr. George Felbeck of Union Carbide and Carbon, in a discussion sponsored by the American Chemical Society in Washington just last week, when he said: "Why take one of these government jobs and after you have it, why stay with it?" Corporations as we know them are creations of the American system and they exist and flourish because of that system. If we lose a war, we know the system will change and that corporations will cease to exist. It is simply a question of survival. The men in government are devoting their lives to the preservation of the environment in which we can do business. There is no privilege reserved to corporations or corporation employees which allows them to shirk their duties of citizenship. It is the duty of every corporation to make those contributions to the defense of this country which it is qualified to make."

The second motive has arisen out of the feeling that it is prudent and forehanded to become conversant with this new technology and science which may influence so widely the future course of engineering and production. But more of this later—

Contributed by the Nuclear Energy Applications Committee and presented at the Annual Meeting, Atlantic City, N. J., Nov. 25-30, 1951, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

let's look at some of the handicaps or deterrents to industrial participation in this type of governmental-industrial relationship.

First, and most obvious, is the fact that the atom business is a government-owned operation. To quote from the magazine *Business Week* in one of its 1950 issues: "Atomic energy under the McMahon Act is an island of socialism in a sea of private enterprise. Never before has so potentially important a technology been subjected so completely to public control."

This is hardly the kind of an atmosphere that would sound attractive to private enterprise. This was particularly true back in 1947 when industry had the pleasant prospect of satisfying the pent-up demand for the billions and billions worth of civilian goods denied a high-earning large-saving American population during six years of war and reconversion.

The fact that the atomic-energy program is a governmental monopoly means that—for industry—the *normal* profit incentive is lacking. For the same amount of talent and effort put into its own business, even after taxes, any industrial concern would expect to earn profits, far in excess of the fees allowed under an AEC contract. It must be remembered, of course, that industry makes little or no financial investment in the atom business and takes no very great risk of substantial financial loss. Nevertheless, a very real investment is exacted of the contractor in terms of the qualified men required to be assigned to the job. Top technical and management brains are necessary even though they must be diverted from other work. Taking these facts into account and recognizing its obligation to the taxpayer—the AEC sets the fees paid for management services at the lowest figure that can be negotiated. Under the conditions that have existed to date this system has seemed about as fair as any that could be devised. Nevertheless, the normal (and I emphasize *normal*) profit incentive is lacking.

A second deterrent to private participation is the patent situation. Under the Atomic Energy Act, inventions and discoveries made in connection with the work become restricted data if connected with fissionable material or weapons or become public property available for nonexclusive licensing if they are nonmilitary in nature and therefore declassified.

There appear to be two viewpoints on this particular problem. One group feels that if normal patent incentives were restored throughout the atomic field, private money would flow in and development would go forward in a manner more businesslike, faster and cheaper. Equipment and processes developed in the atom business would be available for use in the contractor's regular business. There are some who see in the patent clauses of the Atomic Energy Act an attack on the patent system generally.

Opposing this view is the one that suggests that there has been very little possibility of private industry making much of an investment in the atom on a risk basis. The price tag has been high and the market extremely limited and uncertain. Weapons uses seem inevitably to dominate the field in the foreseeable future. This second viewpoint holds that when the time arrives for commercialization of some aspects of the atom business, everyone will be on even terms. There will be no special legal or economic privileges deriving from patent advantages held by the insiders—the AEC contractors. You will have to take your choice in this matter but here again remember that public money is involved.

A third handicap is the vital security regulations that must be added to the usual problem of government red tape. This causes exasperating delays in building up staffs of personnel who must be cleared after time-consuming background investigations. It requires the expenditure of millions of public dollars that must appear wasteful to the average hardheaded industrialist, until he has been educated on the importance of security. On the red-tape side—well—need one say more about this?

There is also the fact that health and safety standards are much more rigid in atomic work than in normal industrial operations. To an outsider not familiar with the scope of radiation hazards, the AEC precautions may seem unrealistic. Potentially, the atom business is one of the most dangerous in the world. In practice, it is one of the safest. But the time-consuming precautions require men and may make a potential contractor hesitate before committing his firm to an AEC contract.

Given the lack of normal profits, the absence of patent protection, the unusual expense in terms of manpower, the complex security regulations, unusual health standards, and a fair supply of red tape, one might well ask why private enterprise hasn't pulled out of the atom business entirely and let Uncle Sam run it as best he could with government employees. As you may know, this had been proposed by certain groups in this country. We in the AEC feel that any approximation of such a course would be a national calamity. And we believe that there *are* reasons why this has not happened.

Those contractors who shared the load during the war acted without hesitation under the most impelling of motives—a patriotic sense of duty to the nation. But they could have withdrawn at the end of the war. A few did, but most of them are still in the program. Here are some reasons for their action in continuing—reasons which, I repeat, I have heard from the men who head the larger of our contracting companies.

Prestige might be put near the top of any list of incentives. It is sometimes difficult for critics of the capitalistic system to believe that the industrialist has any interest other than profits. You and I know that pride of achievement is one of the great driving forces that has made this country the greatest industrial nation in history.

When the war ended within a fortnight after atom bombs fell on Hiroshima and Nagasaki, there was glory for all who had a part in the magnificent gamble. Since then the record of the AEC in achievement, in my judgment, has been good. People, by and large, think that the progress in atomic weapons under the management of the AEC has constituted a significant contribution to national security and the preservation of a degree of world peace. This has meant good will and prestige for those industries that have made this progress possible. I believe this factor is most persuasive in encouraging other segments of industry to come into the program.

Another tangible asset is the improvement in technical resources and staff that comes with participation. This is the other side of the coin which complains about diversion of top men from a contractor's regular private business. The atom industry is still a challenge; it retains the air of—and it is indeed—an adventure; it appeals to young minds despite the distasteful aspects of some elements of the security regulations. AEC contractors thus have a decided advantage in building up more competent technical staffs.

The AEC supports a policy of trying out new processes, new equipment, new gadgets. We are still young enough to be unorthodox when such a course seems to promise progress or cut costs. This appeals to the good engineer. He is called "the enemy of error" and at many stages of our work, trial and error is the only method of solving a complex problem. All these factors make the atom business appealing to many industrial leaders and can result in adding great strength to the resources of any given organization.

Finally, there is the idea of "getting in on the ground floor," which I mentioned earlier. No industrialist knows just what the atom will mean to him. But he doesn't want to be left

behind when the parade starts. Admittedly, the parade hasn't started yet, but from time to time, one catches the distant rumble of the processional drums. There are enough new things being done in chemistry; metallurgy, electronics, and a dozen other areas of this business to make this desire to be in on the ground floor a powerful factor in attracting new blood to the program.

I think it is fair to put it in the record at this point that the AEC has taken a number of steps to make things as attractive as possible to private enterprise. The over-all government ownership and control is a matter of law. Continuation and expansion of the contract system has been a matter of policy. The agency has limited the role of the government largely to policy making, security, standards of performance, and contract administration. Proof of this is seen in the employment figures. Of more than 100,000 persons engaged directly in the program, only about 6000 are on the AEC payroll—something on the order of one in 20.

Some segments of the atom business have been left almost entirely in private hands. Uranium mining is the most conspicuous example. Our atomic resources rest on the narrow base of the presently available supply of uranium. This base must be enlarged. While we continue to rely on foreign sources for a major share of ore, a remarkable increase in production has been achieved in our own country through the encouragement of private enterprise.

In addition to the setting of minimum prices for the ores—prices guaranteed for a period of years—one might cite the Commission action in publishing of the handbook "Prospecting for Uranium" of which 75,000 copies have been sold. Then, too, a chain of assay stations has been established where more than 1000 samples of ore are processed each month.

In the isotope field, the AEC is encouraging free enterprise in a number of areas. The manufacture of special isotope handling and processing equipment is a fast-growing industry and is almost completely in private hands. This has led to the building up of private analytical research staffs for consultation and development and for servicing of these privately manufactured devices. The dozens of companies in this new field compete on a normal basis for the available business and seek to develop new accounts. Collectively, these companies are playing an important part in widening the application of radioisotopes in many fields, especially in industry.

Another AEC policy has been to turn over for commercial development some of the processes proved out in the laboratory. The MED did this with uranium processing during the war. Industry has reciprocated. Mallinckrodt developed a continuous processing system which replaced the batch method for certain stages in the making of uranium metal. Other contractors have taken devices and systems developed successfully in AEC laboratories and improved them in industrial operation. Presently, we are attempting to interest private companies in the production of zirconium metal and are willing to guarantee a market for a period of years as an incentive.

A positive technical-information program has been developed by the AEC. The lack of information was one of the principal points emphasized in an excellent survey made by a special Industrial Advisory Group several years ago. In its summary, made in December, 1948, this group said:

"The essential pre-condition to increased industrial participation is knowledge of the subject so that industry may recognize opportunities to take part as they arise...still secret information which is properly declassifiable and of special interest to industry should be declassified and published."

This need has been met in a number of ways. Following the report of the Industrial Advisory Group, the Commission asked representative editors of the professional engineering-society journals and of the business press to serve as an ad hoc advisory committee to investigate whether technical information that would aid American industry was being needlessly classified, and to recommend ways and means for dissemination of unclassified and declassified information to industry generally. S. A. Tucker, manager of publications for ASME, and George A. Stetson, editor of MECHANICAL ENGINEERING, serve as members of this committee. The committee has investigated two collections of data—that in the patent files and that clustering around the electromagnetic separation plant at Oak Ridge. They came to the conclusion that the AEC record of declassification of technical information is fairly good—that little is being held back that would greatly aid industry.

Early this month we took the second step—the strengthening of our information distributing system. The ad hoc committee met with representatives of the AEC contractors, the field officers of AEC, and the Washington program divisions. They hammered out together recommendations for speeding up the flow of information through the professional journals and the business press.

Starting with the July, 1949, issue, each of the semiannual reports to Congress has given exhaustive treatment to a specific field of atomic-energy development. Special reports such as the three-year summary of isotope distribution and use and a handbook on aerosols have been issued.

Some 40 libraries have been made repositories for all unclassified and declassified reports. These collections now run to about 4000 papers, and should increase at the rate of about 1000 a year. A special bibliography of some 250 papers of special interest to industry was compiled in the spring of 1949.

Over 300 patents are now available for license to industry. They cover a wide range of processes and inventions. AEC-printed scientific reports are available at nominal prices through the Office of Technical Services of the Department of Commerce. The monthly average of sales is between 500 and 600, of which roughly one half are requests from private industrial laboratories.

Of special interest to you as engineers is the recent announcement that a source book on engineering in atomic energy is to be prepared under an AEC contract. It will be edited by Dr. Samuel Glasstone, the well-known textbook author, and will be a companion volume to his excellent "Source Book on Atomic Energy."

Also, in the works is the publication of a study of present and future world resources in energy which should be of special interest to the power industry. I believe you will agree that all this adds up to a rather impressive program of information which should be of assistance to industry and management.

One of the maddening bottlenecks we have mentioned is the lack of trained personnel in the science and technology of this new business.

The AEC does not wish or feel qualified to substitute for or replace the colleges in engineering education. But it will take time for nuclear technology to be integrated generally into the curricula of engineering schools. In the meantime, the AEC has started a stopgap operation which grew out of one of the recommendations made by the ASME in 1949.

The classified Reactor School of Technology began operation at Oak Ridge, Tenn., with 43 students enrolled for the inaugural 1950–1951 session. Only four of these were from industry. The second session began in September with 75 enrolled for the 12-month course. This time there are 24 students from industry. Their employers will pay their salaries while they study, with the AEC providing the facilities and the faculty.

Another encouraging sign was noted in the recent unclassified symposium on atomic-energy engineering held also at Oak Ridge. More than 500 attended the two weeks of lectures and among these were 57 from industrial organizations *not now* on the AEC list of contractors.

Another ASME suggestion was the part-time employment by AEC contractors of specialists from non-AEC concerns. This program has been put into effect. The arrangements are made on an individual basis between the person to be employed, his company, and the AEC contractors. Thus the AEC, in some small ways, is helping to break this bottleneck of the lack of trained manpower in the scientific and engineering fields.

From this enumeration of operating policies designed to encourage more participation by industry in the atomic program, you can judge whether or not we have gone about as far as we can within the present terms of the Atomic Energy Act. Now let's take a look at the future and some of the problems of opening the door for private investment, risk taking, and profit-making in atomic energy. Remember the law admonishes the Commission to so conduct its operations as to strengthen competition in free enterprise.

In its latest annual roundup, *Business Week* said: "As recently as a year ago, you had to look hard and long to find serious interest among businessmen in atomic matters. To most of them this was something for the military, the scientists, and the government to worry about. More than once, the AEC people had to beat on the desks and make patriotic appeals in order to find companies willing to take on projects for it.

"Today, you can see signs of a rush to get into the field before the ground floor gets too crowded. Many companies are coming to AEC asking for assignments, and it needs only a hint of government receptiveness to bring in more.

"For the first time, businesses are spending a little of their own money to get a toe hold in the area. Several are thinking about large investments."

This was, by and large, an accurate report and there are two obvious reasons for the change in climate. First, the atom business is getting so big that it involves almost every kind of industry at some point or other. Second, as we continue to make significant strides toward the production of useful power for the propulsion of military vehicles, the prospect of central-station power from the atom fuels becomes more exciting.

If I have one message to leave with you today it is this—don't sit back and wait for things to happen in the atom business. Continue to be impatient about the future and the enlargement of industrial participation on a basis that will allow your companies to earn a return on your efforts commensurate with the risk they will take. And look for the opportunities to take that risk. If you do not do this, it is my opinion that you may well be witnessing the first step in the extension of governmental control over our basic industries. For this reason alone I am glad to take note of the *Business Week* story that I just quoted and to urge that each of you review with your companies the possibility of developing an interest in this new field.

There should be no misunderstanding, however, about this one point. The law charges the Commission to develop the use of the atom for the benefit of the nation and mankind subject at all times to the paramount objective of promoting our common defense and security. Today this means getting on with the weapons business. This grim job we are doing and doing with a grim will. You know, however, that the process of manufacturing fissionable material is the same whether the material is to be shaped into parts of weapons or into fuel assemblies for peacetime uses. The present international situation requires that the government continue to own and control the source materials and the finished product. Should the efforts of this and the other free nations to obtain an effective system of international control and disarmament succeed, it would appear possible and desirable to release into normal competitive channels those materials which hold such promise for the future.

Until that time arrives it is the duty and responsibility of each of us to learn as much as possible about current technology in the atom business. How else will you be able to enter the field when and as the opportunity presents itself? Let me take the time to recount briefly the steps which have been taken during the past year by alert and progressive companies willing to risk an investment in the future.

First, the Abbott Laboratories of North Chicago have leased space in the town of Oak Ridge and have a small manufacturing operation under way there for the preparation of certain radioactive compounds of short half life. These will be sold to hospitals and medical research laboratories.

To my knowledge, this is the first commercial operation aimed at national distribution to be set up in one of our atomic cities. Abbott subleased its space from an undertaking establishment and pays the same type of rent as do other local businesses. Although small in scope, it is a significant step.

Along the same line, two other corporations, Bendix Aviation of Detroit and Tracer Lab of Boston, are studying—at their own expense—the commercial feasibility of manufacturing, processing, and selling radioisotopes. A reactor large enough to manufacture a variety of radioisotopes will cost a substantial amount. The market, while large in one sense, is principally supported by government laboratories or agencies where research is government financed. There would seem to be strong deterrents against any optimistic outlook here—and yet, it is just this sort of situation that I would expect an alert competitive company to accept as a real challenge.

And then, there is that most important development—atomic power. Many of you are familiar with the story. The first proposition came from Charles Thomas of Monsanto Chemical. He proposed that Monsanto—at its own expense—put a team of "cleared" scientists and engineers to work on studying our reactor program. Thomas figured his people might find a better way of building reactors that would make plutonium cheaper than the AEC can make it and make power at commercially competitive rates as a by-product of the plutonium manufacture.

Others got interested in Monsanto's idea and as a result, the AEC has contracted with four groups of chemical and utility companies for the first phase—the study stage—of this far-reaching proposal. To date 92 persons from these companies have been cleared and 40 are working full time on the project.

The companies that will invest at least a million dollars in this very preliminary study phase are Monsanto and its associate, Union Electric, both of St. Louis; Detroit Edison of Detroit, and Dow Chemical of Midland, Mich.; Commonwealth Edison and the Public Service Company of Northern Illinois, both of Chicago; and the Bechtel Corporation and the Pacific Gas and Electric Company, both of San Francisco.

With the exception of Monsanto and Dow, all of these are newcomers to the atomic business. Bechtel is now busy with its first AEC job—constructing the chemical processing plants at the National Reactor Testing Station at Arco, in Idaho.

What will they come up with? I don't know but I am satisfied that much of value will appear in their reports. You just can't let intelligent, aggressive engineers and management

people loose in this business and draw a blank as a result of their efforts. No one of these companies will willingly throw away the money they are spending on these surveys. As a minimum, then, let's say that I am more than mildly optimistic on this deal.

Along with the activities just described we can list others in which the Commission has taken the initiative in developing some more normal industrial participation in portions of the atom business.

Some months ago, the AEC commissioned the Stanford Research Institute to make a survey—to conduct a "market analysis" if you wish to use the language of business—to develop industrial uses for a valuable source of atomic radiations that up to now has been an expensive economic waste. This source is the highly radioactive fission products resulting from the operation of reactors.

The Stanford group turned in a preliminary report last month. It suggests that present commercially feasible industrial uses for these waste products include the activation of phosphors for self-luminescent signs and markers; static eliminators for a variety of industrial processes; the reduction of starting-voltage requirements in fluorescent-light tubes and in process control instruments which incorporate a source of radiation.

Under possible future uses, providing the technology can be developed, are listed industrial radiography; cold sterilization of drugs and foods; and portable low-level power sources.

In the opinion of the investigators and I quote, "The technological and marketing problems confronting the Commission in making fission products available to industry are difficult *but not insurmountable*."

A second example of Commission urging is to be noted in our attempts to turn over to private hands the production of zirconium metal for which the Commission has a continuing requirement. Thinking back over the development of aluminum and titanium one may hazard a guess that zirconium, too, will find an important place in industry as the years go by. In my opinion, industrial uses will be developed more rapidly under private sponsorship than under government control.

Thus in these several areas we have the first glimmer of possible action by private industrial concerns—private enterprise, if you will. It is too early to know any of the answers and we in the AEC are wary of prediction.

Nevertheless, what I would like to see is more industries knocking at our door and asking, "What's in this for me?" and being prepared to lay money on the line to find out, like the chemical-utility groups are doing. And I say to you in the ASME—instead of depending solely on coming to us as an organization, go as individuals to the companies with which you are associated and spur them to action.

As more companies get a dollar stake in the atom business, we will have a more critical examination of the assets and liabilities of the business. This is essential if we are to get intelligent and workable answers to the questions that we will face in the future—the questions of how the military and the general civilian applications of atomic energy shall be operated and industrially developed—whether by Government monopoly or by private enterprise or by a mixture of the two. The kind of answers that the people and their policy-making representatives give to these questions will play a large part in making the kind of America that our children and grandchildren live in; and in fact the kind of a world that the coming generations around the earth shall live in. My plea this afternoon is that engineers and the management of industry give their effort and their thought to searching out and actually performing the proper role of private enterprise in atomic energy.

Unless this is done the likely thing will be that atomic-energy development and operations, in the absence of any desire, any demonstration of the capabilities of private enterprise in this field will by default continue as a government monopoly and become more rather than less of a straight government operation. This nation needs its best brains and skill at work on these problems as the free world struggles to combat foreign ideologies and the aggressions which they foment. These aggressions must be opposed—they will be opposed—but let us accomplish that purpose without resorting to the methods of the aggressors—the totalitarianism that we abhor.

Experiment in Generating Power Successful

SMALL amounts of electric power have been produced from heat energy released in the operation of the experimental breeder reactor, recently completed at the National Reactor Testing Station in Idaho, it was announced by A. Tammaro, manager of the Chicago Operations Office of the Atomic Energy Commission.

In a trial run on December 21 and 22, 1951, electrical power of more than 100 kw was generated and used to operate the pumps and other reactor equipment and to provide light and electrical facilities for the building that houses it. Test operations will be resumed early this year after further adjustments of the reactor system.

The heat energy generated was removed from the reactor by a liquid metal at a temperature high enough to generate steam to drive the turbine.

This new reactor was designed and is being operated by the Argonne National Laboratory, Lemont, Ill.—the reactor research center run for the AEC by the University of Chicago. The tests were supervised by laboratory director Walter H. Zinn and H. V. Lichtenberger, the laboratory project engineer for the experimental breeder reactor.

The principal function of the breeder reactor is the long-range goal of converting nonfissionable material into fissionable material more rapidly than nuclear fuel is consumed, a process that would contribute to expansion of the current atomic-weapons program.

The power-generation phase is incidental but is being carried out to secure experimental information on the handling of liquid metals at high temperatures under radioactive conditions and on the extraction of heat from a reactor in a usful manner. The system at the breeder reactor can never generate large amounts of electrical power but it does provide a useful tool for carrying out such experimental studies.

Dr. Zinn emphasized that no comparisons should be made of the cost of producting electric power from this reactor with power from conventional sources. Cost was not an essential factor in the power phase of the Idaho reactor and the experiment is in no way intended to establish the feasibility of producing electrical power economically from nuclear sources. The technical information gained, however, may be useful in the design of future reactors aimed at generating electricity at a competitive cost.

The reactor itself and its principal components were erected at the Idaho testing station by the Argonne National Laboratory. The Austin Company, Cleveland, Ohio, designed the building and some of the reactor system. Construction at the site was by the Bechtel Corporation, San Francisco, Calif., under the supervision of the AEC's Idaho Operations Office headed by L. E. Johnston.

Total construction cost was about $2,700,000. Approximately $2,500,000 was spent by the laboratory over a four-year period for research and engineering development.

MORAL *and* SPIRITUAL CONCEPTS *in* WAR PRODUCTION

By ERWIN H. SCHELL

PROFESSOR OF BUSINESS MANAGEMENT, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, CAMBRIDGE, MASS. MEMBER ASME

IN these moving days, in this uncertain world with civilization on the march, thoughtful people hunger especially for the expression of those deeper truths which form our fundamental personal convictions. To state these truths simply is the mission of this paper.

Those of us whose lives are dedicated to the creation and application of technological ideas must of necessity base our concepts upon sure and often hard reality. Our basic training in separating fact from fancy—generally called the scientific approach—makes realists of us, realists who are deeply sensitive to the very real moral and spiritual values of the facts with which we are qualified to deal.

Morality in its essence is that code of human conduct which embraces the greatest good for the greatest number. It touches each of us in the old quatrain:

> "What kind of a world
> Would this world be
> If everyone in it
> Was just like me?"

It was not yesterday that we as a nation dedicated ourselves to the principles of life, liberty, and the pursuit of happiness. For many years we have believed these principles to be of the highest moral value. Of this we are still convinced today.

LIFE

Apart from that great miracle of consciousness which life means to each of us; apart from the deep concern which we each hold for the lives of those we love, we are strongly aware of the loss which war's decimation brings to the nation. We are seeing with our own eyes the postwar struggles of other countries which have been shorn by war of whole sectors of age groupings of extraordinary importance to their welfare and progress. National life—a nation's life—is just as responsive to a proper balancing of her resources as is our own human existence.

Production for national defense—for the protection of human life—has no peer in importance. Our greatest hazard is our inability to sense the extent of war's havoc should the enemy find us unprepared.

Visiting during the past summer some of the coastal cities of England, I commented to my English friends on the silver lining to the past clouds of war which may be found in the new and modern structures now replacing destroyed buildings in slum areas.

"True," they responded, "but you cannot appreciate the loss of life that took place. It was terrible—terrible—terrible!"

LIBERTY

Here in the United States we have never known what it means to lose our liberty. We have somehow taken liberty for granted, what with our splendid isolation and vast assembly of resources within our borders.

At the close of World War II, I received a letter from one of my former students in Norway, in which he said:

> I will never forget the first morning when I went down to the office after the Germans had given up the fight. I said to my friends with whom I travelled down that isn't it impossible to believe that now is the car standing at a station and yet we can speak aloud and have no care as to who hears what we are talking about. You in America can never understand that feeling even if you live to be a hundred years' old.

Our concept of individual freedom is so deeply ingrained within us that it seems a very part of us. Indeed, our whole structure of competition is based on the exercise by the public of the so-called Fifth Freedom—the freedom of choice.

The most humble among us knows full well that war is the great enemy of freedom from within as well as from without our national confines; that when at war our country suffers grave internal changes in the direction of increasing dictatorship and lessening individual discretion.

At present the crucial issue before our country is that of attaining, by means of war production, a position of national security with a minimum disruption of peacetime pursuits and a maximum retention of individual liberties. Here, again, it is becoming crystal-clear to us that increased productivity is the only road to our ultimate security.

THE PURSUIT OF HAPPINESS

We are inclined to view the pursuit of happiness somewhat more as a matter of personal privilege than as a moral principle. The deeper concept is that our pursuit of happiness is effective only as it takes place along the road of progress. And progress itself demands opportunity. It is when opportunity is available to us that our zeal is roused, and it is only from the products of our zeal that our progress is made and our happiness is approached.

Moreover, the progress we hope and strive for is often the providing of a better life for our children and a better world for them to live in. This objective touches the deepest chords of our being and spurs us steadily forward with that consistency of personal effort which is the price of any worth-while accomplishment.

The reason for the apathy of the peoples of European countries and their lack of interest in productivity may in large measure be laid to their inability to see for their children any material improvement in status or opportunities which life may hold for them because of their confining caste relationships.

America is known around our planet as the land of opportunity. As one European said to me:

> We do appreciate what the United States is trying to do to help us. But we urge you to consider your own security first. For if you fail, the last and greatest bastion of hope for the world falls also.

Contributed by the Management Division and presented at the Annual Meeting, Atlantic City, N. J., Nov. 25–30, 1951, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

THE SPIRITUAL CONCEPT

The idea that there may be a spiritual concept inherent in war production may well seem questionable to my listeners. Yet history provides us with ample evidence that the Sword and the Cross have served inseparably over the centuries as our chief weapons of defense against our enemies.

In England and in Denmark I saw the symbol of the cross cut through the outer ramparts of ancient castles. When I sought explanation of the enlarged circular aperture at the base of each cruciform, I was told that it was through this lower opening that the arrows of the castle defenders rained down upon the invading hosts.

Again, when we review the exciting days of our country's early history, we learn of Pilgrims carrying their bellmouthed muskets with them to church; and at a later time we find more modern men-of-arms responding to the counsel: "Trust in God, my boys, and keep your powder dry!"

On an office wall in St. Louis there is hung a square of tin, riddled by shrapnel, and bearing the letters "Y.M.C.A.," a relic of World War I. And from the Korean battlefront there now come tales, as in other wars, of men who were spared instant death from enemy bullets embedded deep in the Bibles carried over their hearts.

FAITH

The beginning of all wisdom in these matters of the spirit and the sword calls for an act of faith on our part—and "faith is the substance of things hoped for, the evidence of things unseen." A delusion is prevalent that faith is an attribute most difficult for the scientist and engineer to encompass. Nothing can be farther from the truth. No professional group is more humble before the existence of the unknowable than are these practitioners in the fields of the natural sciences.

HUMILITY

And humility here requires but a sunny day and an upward look, for in the blue sky above us we sense but cannot perceive an infinity that is at once real and yet incomprehensible. Likewise, in the ceaseless peregrinations of the electrons within the atomic nucleus, we are confronted, according to the scientists, with the presence of particles which may not be individually identified and which travel along unforecastable paths, thus defying the application of our logical thought processes.

Between these confines of the very large and the very small, our minds also find areas which firmly refuse to bow to the power of analytical thought. So simple a quality as the beauty of a flower defies our objective explanation; and we must turn to the poet for aid. The incidence of time itself becomes elusive when we attempt to pin it to reality and to separate any given instant from the one which has gone before and from the one which follows.

These limitations upon our reasoning powers are readily accepted by the technically trained mind. Indeed, the man of science frequently finds ways of using, if not comprehending, imponderables. Infinity, for example, was early put to work as an important though undefinable element in the mathematics of calculus.

Reason helps us only partially to sustain our religious convictions. Our chief intellectual opportunity in the building of our spiritual resources is found in the study of our personal experiences with spiritual cause and effect.

To assume that the scientific spirit or process of thought prevents the ready acceptance by the engineer of religious convictions based upon faith or experience is as unreal as to hold that the youthful technologist will feel himself called upon to select the young lady who will make him a suitable wife solely by the exercise of his analytical ability.

Rather is it true that the engineer finds himself in an unusually advantageous position from which to sense the practical applications of spiritual insight inasmuch as he is here concerned with matters of dynamics rather than of statics, about which his technical background affords some familiarity.

TIMING

It is not difficult for us to understand that time and timing are inescapable elements in all human affairs, and frequently of dominating importance. For example, we readily appreciate that the conservative point of view often may be identical with that of the progressive or liberal and differ only in the matter of timing, rather than in the ultimate objective.

Again it is not hard for us to view the concept of world peace attainable solely through the exercise of brotherly love, as a procedure involving a considerable interval of time between cause and effect, with the prospect of subjection if not annihilation in the meantime. Conversely, we are equally quick to realize that the proposal to bomb a large number of foreign cities as a fitting prelude to international amity assumes that the background for today's technique has not changed or advanced since ancient times, when to sack and to burn were considered effective methods of preventing subsequent wars.

So when I hold that the spiritual concept in war production calls for the presence of deep and abiding faith in the everpresence of God within each and every one of us, I am not troubled concerning the acceptance of such an affirmation on the part of the scientist or the engineer.

It is this basic belief in the sacredness of the human soul that founds our democratic way of life. It is this profound appreciation of the inherent preciousness of every individual that opposes any national program which condones a smouldering warfare requiring the continuing loss of life of even the smallest segment of our population. Under enlightened concepts of government, man is never viewed as an expendable.

For our enemies whose only policy of advance is along the pathway of human domination and subjection, our spiritual inheritance demands that we build the enginery of retribution for their aggressive acts so immediately devastating that there can be no hope of victory and only the prospect of prompt and severe punishment for any act of aggression.

From far back in the centuries there comes a legend. It is the story of a dragon, awful in his might, with poisonous breath, taking steady toll from a little village; of a knight in shining armor and of his trusty steed which bears him unto the battle. And the legend tells of the great lance which the knight plunges down the throat of his foe. Somewhere there must have been an artisan—an early symbol of war production—who had prepared his liege lord for battle. Somewhere there was doubtless another lance ready in the event that the first one was broken. And a lance there must have been, for it was more than a weapon. It was also the proud standard from which flew the banner bearing the crimson Cross of St. George.

OUTLOOK

In the crucial task of war production, the scientist and the engineer stand in key positions of extraordinary importance. We well know that it is only through scientific research and development that our military pre-eminence may be attained and maintained. And we are equally aware that it is chiefly through the continuing mechanization effected by our engineers of our manufacturing processes that our industrial productivity will increase.

Fortunately, the environment for our continuing technological development and advance is a friendly one. Our

people are acclimated to technical change; our executives are not averse to progress, despite the constant readjustments it entails. And our military arms are deeply cognizant of the vital part which science and engineering play in the building of national security.

Now, at long last, it is becoming evident to all that, even as the loveliness of the rose requires the sustenance coming from roots deep beneath the soil, so the beauty which is freedom must depend upon resources founded solidly upon the realisms of human nature as they are reflected in our moving world of today.

WAR PRODUCTION FOR PEACE

We stand ready to uphold our moral and spiritual convictions even at the price of war. Yet of immeasurable value to us is the principle of peace itself.

Can war production insure peace in our time? While it may be true that wars are based upon hatred which fear arouses, yet it also goes without saying that those dictators in whose hands great decisions rest will not favor conflict unless there is the reasonable probability of victory.

Peace is possible for the world only when the United Nations encompass such military power that war is certain to bring defeat to aggressors.

PEACE WITH PLENTY

There is more to peace than this. Not only must war be made unattractive but peace must appear economically desirable in the eyes of every government. The United States, for more than one decade, has enjoyed an economy of plenty, thanks to the creative abilities of its scientists and engineers and the skill and accomplishments of its industrial leaders.

Our second responsibility, then, is to accelerate our national productivity through further mechanization of processes, further improvement of methods, and further development of new and better products, both for war and for peace. Thus our prosperity will prove that there is in modern technology and scientific administration the basis for continuing growth and prosperity for the peoples of any nation. Next to our military needs, the war production of the greatest significance is that of peacetime productivity itself. This is a time for guns *and* butter and constructive advances in industrial output of any nature are direct contributions to the peace effort.

PEACE WITH MORALE

Nor is this enough. Somehow, a high national morale must be developed and maintained. The business of peace demands a public attitude which not only supports peaceful pursuits but strongly favors the industrial activities which make such a condition an assured reality. Our people must find in our system of industrial enterprise a certainty of continuing improvement in the products of our mills and factories, if they also are to continue to favor and to further our industrial way of life.

Here again the engineer and scientist are called upon to contribute new basic knowledge, new operative procedures, and new devices which incorporate the steady advances vital to the maintenance of national morale.

I once asked a top official in a great corporation, enjoying for many years the good will of the public, just what he based this accomplishment upon. He replied:

> We have aimed to do two things—to provide our customers with a really good product, and to provide it at what seems to them to be a reasonable and a fair price. To continue to do this every year we have found it necessary to spend many millions upon research and development.

PEACE WITH PROGRESS

There is a final requirement for peace. The outstanding difference in the atmosphere in which business is conducted in Europe, when compared with that of the United States, is the extraordinary degree to which secrecy and unwillingness to compare industrial procedures are still found prevalent. Our creative advance in this country is in no small measure the result of industry's manifest desire freely to compare ideas and procedures to the end that all involved may benefit.

For many years this great Society has actively ministered to this cause and it is certain that these efforts have contributed in large measure to the relative eminence of American industry in the world today. Peace depends upon truth widely disseminated and the objectives furthered by our technical associations have been direct contributions toward attaining this ideal.

CONCLUSION

My conclusions may be briefly stated.

By an unexpected turn of human destiny, the scientist, the engineer, the technologist suddenly find themselves the central figures in world events. Without their genius for organized creativeness, nations may fall; with their support and assistance, a new world is in the making.

Now we see that the moral and spiritual tenets upon which our country was founded—life, liberty, the pursuit of happiness, and an abiding faith in the constant presence of God—are not inimical to the concepts of science or technology. Now we know that as we continue to unlock and to use the secrets of the natural universe about us, we are making possible a greater application of those ideals upon which our country was founded and an earlier coming of that day prophesied—a day of peace on earth and of good will toward men.

ALL AMERICA prays that the battlefields in Korea will be stilled in 1952. But the battle for production will still go on.

It is a long battle, one that will demand from the American people not only energy and drive but also the utmost in patience, persistence, and endurance. It is aimed at expanding our basic national strength so that we can support as long as necessary a high level of military strength and still maintain a productive and expanding civilian economy.

The second year of that effort is now beginning. In many ways, it will be the most difficult year.

In military production, 1952 must be the year in which we finally break our most persistent bottlenecks. Critical machine tools must be turned out at rapidly increasing rates, and the flow of materials and components must be synchronized so that the planes and tanks can be assembled without delays. We must find ways to save thousands of tons of our most critical metals—above all, copper—so that our limited supplies may be stretched to cover a maximum productive effort. The exploitation of new sources of supply of the scarce minerals must be pursued aggressively and the construction of plants for the production of basic materials, notably steel and aluminum, must be carried forward rapidly.

To make the most of our manpower resources, we can proceed on many lines—all of them desirable from the human standpoint, as well as for their economic benefits. We must make sure that decent housing and community services are available to defense workers who are called upon to migrate to new communities. We have almost unlimited possibilities of adding to the skills and productivity of our labor force by training; by better utilization of older workers, handicapped persons, and minority groups; and by programs of health and safety. (From the Fourth Quarterly Report to the President by Charles E. Wilson, Director of Defense Mobilization.)

REDISCOVERING AMERICA

By WILLIAM L. BATT

CHIEF, SPECIAL MISSION TO THE UNITED KINGDOM. HONORARY MEMBER ASME

IT WAS my privilege to address the Annual Dinner of this Society in December, 1940. It was at a strange moment in our history.

France had fallen. Britain was battling alone. We were on the side lines wondering if, or when, war lay ahead for us. We were beginning to build up our defenses, but many were afraid we weren't building fast enough. We were troubled about raw materials and about inflation. We were afraid our people were too lethargic, too content with "business as usual," to face up to the national peril in time.

Things looked bad. As I said that evening, "There is war all over the world, a war that threatens to destroy the progress of the human race without wiping out any of its mistakes . . . . the highest ideals that man has evolved are in danger of extinction . . . . We are at the edge of a world in flames."

That was in December, 1940. A year later we were in it. And four years later we had come through to what we thought was peace.

And now, ladies and gentlemen, here we are again!

In many ways that 1940 situation is here. We have a war in Korea. There is shooting in Indo-China and in Malaya. Another powerful nation seems bent on world conquest. Once again we are looking to our defenses, worrying about raw materials, about inflation, and alarmed at the nation's lethargy. To complete the picture, there is no doubt whatsoever that the fate of civilization is at stake.

And yet there is a difference between the situation of eleven years ago and that of today. My address, last time, was entitled "Through a Glass, Darkly." Tonight I do not take so dim a view. For the difference between then and now is that this time we and our Atlantic allies are started on a course which stands a good chance of saving the peace.

The war in Korea, tragic as it is for the Korean civilians and for the fighting troops, is not necessarily a preliminary to a bigger war. We can hope that history will describe it as the first positive check to the forces of aggression. To me it is a symbol of the way the remaining free nations are banding together in a common front.

The difference between then and now is that we have a combined defense program among the North Atlantic Treaty nations. If we put forth the energy and accept the sacrifices over the next few years, our combined strength should dampen the most aggressive spirits and soften the most insatiable ambitions. Peace would then be assured for a long time ahead.

There is one part of this allied program which is hard to grasp unless you spend some time away from America. That is the overwhelming part which the American people must play. You may think you are aware of this from the enormity of your mobilization plan or the enormity of your tax bill. But I assure you, one cannot fully appreciate the American role without crossing the ocean.

You really begin to comprehend it after you spend time in each of the western European countries. All of them are diverting a climbing percentage of their resources to the common defense. This military coalition is an imperative. But in evaluating their efforts, you cannot avoid the conclusion that it is the power of America, particularly in industry, upon which the security of this common civilization depends.

I think we became vaguely aware of this toward the end of World War II when the United States acquired the title "arsenal of democracy." We are even more aware of it today as we discover that the war-ravaged industrial nations have not yet emerged from their convalescence.

But it is not the simple fact of our industrial strength that is becoming known. A trans-Atlantic exchange is under way which is revealing all the background facts, the ingredients which make up this production miracle of ours.

As you know, an important function of the Marshall Plan is the provision of technical assistance to Europe. In addition to the supplies and machinery, we have been exporting the methods, the techniques which have made our own industrial machine so efficient. We have been doing this by sponsoring tours of European managers, technicians, and workers through the Detroits, the Clevelands, and the Pittsburghs where the industrial miracle takes place.

These teams, and there have been over a hundred of them, have returned home and written reports of their findings. These reports are important because they are the combined findings of Europe's management and labor. They have the ring of authenticity because they were written by the visitors for their own countrymen. I have read most of the 40-odd reports written by the British "productivity teams" that toured our factories. I assure you they are a remarkable, and to an American, an inspiring set of documents.

And as a result of these reports, millions of people on the other side, the peoples from whom our ancestors came, are now, in the truest sense, rediscovering America. They are getting a picture of what they formerly thought was the secret of U. S. production and discovering that it is no secret. They are learning how we work and how we produce. What is most important, they are finding out some of the reasons why we work the way we do and produce as much as we do. They are beginning to uncover the sources of American strength.

Let me hasten to say that this need not be a one-way street. We in America can learn much from Europe too. There is much these older countries have to offer us from their great cultural traditions and much they can teach us, even in the exchange of technical "know-how." To cite only Britain as an example, we have gained very much from her fine basic research in penicillin, in radar, and in jet propulsion.

But the point I make tonight is that we have fundamental things to learn about ourselves from these reports on American economic life written by the Europeans. It is time that we, too, rediscover our own America.

There are so many things under our noses that we cannot see. We have grown up with them and they are commonplace. To understand what really makes us tick, and what it is that we must never lose, it is good to get away from our own shores, to see ourselves from the point of view of an outsider. For we are, to make a homely comparison, somewhat like the parent who may not realize what fine children he has until he hears them praised by outsiders.

It is good to know that we are strong, that we are productive, and that we are pretty prosperous. This is pleasant and com-

Presented at the Annual Banquet, Atlantic City, N. J., November 28, 1951, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

forting. But if we are to hang on to our strength, our productivity, and prosperity, we must know more. We should be wise enough to identify those forces which have placed us in this position of world leadership. We should understand what it is that we must hold on to. Strong civilizations have collapsed for lack of intelligent leadership; ours has no divine guarantee.

Ladies and gentlemen, I make the point that our very survival depends on understanding and perpetuating the traits responsible for the vigor of our national life. It is the great value of these reports written by Europeans that they explain, as I have seldom seen explained, the things that we must perpetuate.

As you can imagine, these reports are full of technical matter about the methods and machinery of our factories. This technical material is of great help to European industry. But these team reports say that much of our technology was not completely new, because they had seen or heard about it before. What did astound them was something quite different. It was the spirit, the climate, the atmosphere of American industry. The machines, and some methods, they had seen or expected. They were not prepared for the zest, the energy, and the economic reasoning which they found, and which, they reported, were largely responsible for the American achievement. These were the things which impressed the visitors most and which they hope can be transported to Europe. And these are the very things which we are taking for granted.

Each of the teams expressed itself in its own language. But they are in common agreement in appraising the American temperament. And any American who spends any considerable time with European industry learns a new appreciation of this industrial temperament and learns to dread the possibility that we might ever lose it.

Let me single out four views of what I mean.

1 First, there is something you might call "pioneering." Our people are no longer pressing forward on a physical frontier, but the pioneering attitude is still strong. In virtually every enterprise, it is still a normal American yen to break new ground.

Foreign visitors are continually surprised by what they call the "receptivity to new ideas" which is common to our managers and to our labor forces. Let me quote from a British report: "The abandonment of tradition is one of the most striking features of American methods in contrast to our British tendency to cling to the 'good old way'."

It is hard for Americans, living in a climate of constant change, to realize how binding are the ropes of tradition in Europe, but I assure you that overseas the bindings are very strong.

We may well ask whether the disappearance of our own geographical frontier will set us in our ways. Is there any danger for us of the hardening of the arteries which has occurred in Europe? There may be. But if we see that hazard, I shouldn't be too worried about it. The pioneering spirit in American industry has remained with us long after our frontier reached the Pacific. We should be able to maintain it if we remain alive to the dangers of sloth and self-satisfaction.

2 The second quality I would mention is our demand for the better life. You can call it ambition, the aspiration of the individual for a better station, more material things, and for education. This ambition astounds the visitors. We are the nation of unlimited objectives. We say that any American boy can be President, and we really mean it. In many countries the average man doesn't dream of owning the things which the American expects and works hard to acquire. It is this insatiable appetite for improvement which is a key to America's high and efficient production.

This demand has two particularly interesting aspects. One, parenthetically, is the influence of the American woman. She wants—or demands—a great deal. Quite properly, this was discovered by the British internal-combustion engines team which reported on the combustive power of the American woman. This is the quote:

"The American standard is sustained by the enormously greater variety of goods available to the American than to the British shopper. In the competition for a higher standard it is the American woman who is the pacemaker. In striving for higher wages the American worker has, unquestionably, prepared himself unto the battle, and the trumpet, sounded by his wife, does not give an uncertain sound.

"This can be said without disparagement. On the contrary, viewed from the standpoint of industrial productivity, the influence of the American woman is distinctly valuable."

There is a further explanation for the enormous output of consumer goods, and this is the demand of the American worker for high wages. Regardless of how employers may have felt about this wage pressure, there is no doubt about one thing. He becomes more efficient or he doesn't last.

To make up for the high cost of labor, management was forced into inventiveness to cut the costs of all other factors of production. The result has been a vast increase in mechanization and in techniques to raise the output per man. The further result has been more goods for more people and, more remarkable, more jobs. This is something that the American workingman has understood, where his European counterpart has not. The American laborer has given fairly general support to changes which increase production. In Europe an old fear of unemployment tends to raise resistance to laborsaving devices.

Offhand, one might assume that women in other countries also want more things and that workers everywhere look for higher wages. You may feel that such desires are universal and not particularly American. But in other lands people do not assume that the things they want are actually attainable. They do not have that confidence that their best efforts will be fairly rewarded. Millions of them have been led to believe that the only way they could gain a higher standard is through political change. Instead of applying economic pressure at the point in the productive process where it would do the most good, they have diverted their energies to political activity, which certainly does not generate the output of more goods.

3 The third factor in America's industrial temperament is, perhaps, the most striking of all to an American who has spent time on the other side. It is the American attitude toward competition. Here we can voice some strong conclusions.

One is that competition is the motivating force which has produced the industrial machine which is able, and anxious, to provide us with an economy of abundance. If there is one feature which most sharply distinguishes American thinking, it is the American urge for competition. It is impossible to overstate its role in American prosperity and abundance. But I can assure you that until they breathe some of our economic atmosphere, most Europeans have no conception of the strength of the competitive element in our economy, or the value which we attach to it. On the other hand, our businessmen, yes, even those who have had their troubles with the Sherman Act and think our antitrust laws are painfully imperfect, these American businessmen are truly appalled at the lack of competition they find overseas. And they return home with a renewed respect for our own system of free enterprise.

We must not be too self-righteous about this comparison. We are blessed with natural resources which make our competitive system easier to operate. We have a relative abundance of physical resources, a far larger area than any country of western

Europe, and a more recent history of individual pioneering, fluidity of movement, and industrial growth. But when all these factors are admitted, there is still a difference which is one of concept. The American concept is based on the production of the largest volume of goods for the largest number of people at the lowest possible cost. And this is not the motivating view of much of the business community on the other side of the water.

The American concept of more things for more people, of workers being able to purchase the things they make, can only be realized under the spur of competition. It is not that European men and women do not want more things that make for comfortable living. Most European workers remember terrifying unemployment, and job security means more to them than the prospect of obtaining more material things. They are not convinced that competition leads to greater abundance, and they have not yet learned that, in the long run, security and competition are actually compatible and complementary.

In Europe, therefore, because of bad memories dating back to the industrial revolution, competition is considered something of a menace. Even the word is never used without some dire preceding adjective. It is always "ruthless" competition or "cut-throat" competition. Rarely is it coupled with the word Americans prefer, "healthy."

In large sectors of European business competition has been virtually eliminated by marketing arrangements, by price agreements, collective boycotts, and other restrictive practices. Let me make it clear that in most countries of Europe such practices are not illegal, nor are they simply the unwise or selfish policy of management alone. Trade unions, and even governments, seem to have found such arrangements quite acceptable.

One of the best summaries of what European observers found here is the little capsule of history, printed in the British welding report, I quote:

"In comparing British and U. S. industry we should understand that intangible factor, 'attitude to work' . . . . The industrial revolution in Britain caused widespread unemployment and large profits for the manufacturer, resulting in a gap between workers' purchasing power and swelling prices. Unions pressed for higher wages and were countered by the formation of cartels and price rings, so that increased wages were often more than offset by price increases. The result was a shortage of work, which, in turn, aroused a desire by the unions to spread the work available over as large a number of workers as possible.

"Employers found the policy of increasing prices easier than introducing laborsaving machines, and the unions did not welcome such new installations and in some cases actually discouraged them.

"In the U. S., on the other hand, cartels, monopolies, and price rings, after due trial, were outlawed, so that real and sharp competition developed between firms, and this, to a large extent, prevented any major rises in prices. The unions obtained a high wage level. Since selling prices could not be raised, the manufacturers' only recourse was to organize their factories to the highest possible degree of efficiency. The purchasing power of the workers is much more closely related to selling prices than in Britain, and this in turn has stimulated trade with beneficial results to the community as a whole. The efficiency measures are not restricted to machines and handling devices; the labor force is also 'streamlined.' The aim is always to reduce the number of men employed for any process to the absolute minimum. And in this matter the employer is well supported by the union, which has a very special interest, since the success or failure of the company means the success or failure of the union." That is the report of the British team.

It is becoming apparent to many in Europe that competition is ruthless only to the inefficient and that lack of competition is ruthless on entire populations. And some are beginning to understand that they must make a choice. They are still a minority, but their number is growing. They are learning by observing America and also, oddly enough, from what has happened on the other side of the Iron Curtain.

It was the original assumption of Soviet economists that competition was a foul device, useful only to exploiters, and they decided that their Utopia would have none of it. It was not long, however, before they, too, came to grips with the problem of making the economic machine work. Their solution was brilliant. They discovered "a new invention," like so many others they have recently claimed. They invented competition. Managers of state enterprises were ordered to compete with each other to keep production high and costs down. The rewards for success and the penalties for failure followed the familiar Soviet pattern. And, in the usual Soviet manner, once they caught on to an idea they went at it whole hog. They introduced competition with a vengeance into the wage side of the picture. The "Stakhanovism" they are so proud of, and which they are forcing down the throats of all new satellites, is a vicious sweatshop wage system which no decent trade union in the free world would stomach. So here we see two brands of competition—a truly ruthless brand with the single objective of greater output for the state, and the American version of greater output to raise the individual well-being of every individual citizen.

If our form of competition is adopted in western Europe, there will be less need for productivity "drives," for productivity would result automatically. European management would be on its toes because efficiency would become a matter of self-preservation. By cushioning themselves from the knocks of competition, European businessmen, unions, and governments have gained some momentary comfort, but in so doing they have endangered their economy and, in today's climate, Europe's political survival.

The lesson for ourselves is very clear. Our competitive free-enterprise system, with proper safeguards for those who may be temporarily displaced by technological change, achieves the most humane balance between personal liberty and the economic requirements of a large population. Competition is a wonderful lubricant. It makes it possible to mesh the individual's freedom with the necessity to deliver the greatest volume of goods to the greatest number.

4 Finally, there is a fourth factor which is more highly developed in this country than elsewhere. It is responsibility which American management feels for the other elements of the industrial team—the worker, the consumer, and the community.

There is a point in several of the British reports which is amusing and gratifying to an American reader. It is the visitors' discovery of the American use of first names. To quote a British report: "When the president, vice-president, or senior executive walks through the plant, morning greetings are exchanged. To even the lowest-paid laborer it is 'Good morning, Joe, good morning, Bill.'" A small point, but certainly symbolic of something much greater.

As the same report says, "The American has a definite philosophy toward management. Management and labor are a team."

This obligation, felt by American businessmen toward their own firms and the community as a whole, is something which is not general on the other side.

One of our opportunities for helping our friends in Europe to improve their productivity lies in this field of public interest on the part of engineers and businessmen. This concern is natural with us but is still strange to many countries. The Hoover medal, which this profession gives to engineers to en-

courage achievement beyond the confines of their daily work, is just another indication of the broader American approach to these matters.

The desire of American management to develop the team feeling stems from another characteristic, our sense of equality. No one would claim that the situation here is perfect but, again, by contrast with many countries where attitudes are still tinged with feudal memories, we are a classless Utopia. Let us look at ourselves once more in the mirror of the British brass-foundry report:

"The American workman is not a workman in the sense used in Britain. He is an American with the right to enjoy the amenities open to any citizen prepared to work for them. . . . There is no broad division between the boss and employee. Both earn good money. The boss does not drive away in his car whilst the employee looks on from the end of a long bus queue. There is no distinction."

Please note that these are not my words. They are the views of European leaders of labor and management who are reporting on what they saw.

As *Fortune* magazine noted earlier this year, America has now become the land of the "permanent revolution." More rapidly than any other large country we are approaching the goals of liberty, equality, and fraternity. Our businessmen and our workers have thoroughly confounded Karl Marx. They have refused to behave the way Marx predicted they must behave. We have stumbled on the formula to cross him up everywhere else as well.

These then are our strengths:

1 Our pioneer spirit.
2 Our limitless aspirations.
3 Our profound belief in competition and equal opportunity.
4 Our sense of joint participation in a common effort, an identity of purpose that is as precious as it is unique among nations of the world.

The world is coming to our shores to see all this in operation. It has long admired our material achievements and mechanical advances. It is beginning to see something more fundamental, the national ideas back of the achievements.

Today sees us facing large responsibilities. It is vital that we understand the things in our national behavior which have contributed to our present position among the nations. And we must realize how irreplaceable these things are. They must be cultivated and nourished and strengthened. For we have not only ourselves to think about. A large part of the world is looking to us for answers that may mean their political survival.

Because of our relative abundance, even after a war of devastation we have given aid to many peoples. We are producing a large part of the resources needed by the Atlantic coalition for the defense of the West. We may have to continue doing so until the time when potential aggression has been clearly deterred. In our own interest we may have to provide still more of our substance to the straitened economies of the allies who are attempting to rearm while maintaining political stability. Those who dismiss such aid as "foolish give-away" are dangerously ignorant of the facts of life.

And, in the long run, the most important help we can offer will be, not material aid but the grand idea which is back of our enormous production. Our technical-assistance programs, begun under the Marshall Plan and continued by the Mutual Security Agency, the Point Four program, and through our collaboration with the United Nations, are doing many things of immediate value. They are bearing only the first fruits. As time goes on, they will bring a new vigor, a fresh hope, and new strength to a weary world.

Probably never before has so great a responsibility been placed on any nation in so short a time. We have not sought this responsibility, but it is ours, whether we want it or not. Hundreds of millions of people, particularly in the world's underdeveloped areas, are looking for a way to turn. They are getting many suggestions from a nation that thinks Marx is the answer. Everything we say and do is watched by peoples who have not yet made up their minds about the kind of a world they want. It will take more than pictures of our automobiles, refrigerators, and TV sets to make them turn to the United States and the Western World for leadership. They want an indication of hope that these things may someday figure in their own lives. Their final choice will affect their survival and, I am afraid, will affect ours.

The assumption of responsibility on our part, becomes, therefore, not something we owe the rest of the world, but something we must take on for our own survival.

We face the necessity of solving our problems at home in ways which may offer guidance to millions abroad groping for their own solutions. We must find answers for pressing problems of world peace, for raising living standards, safeguarding individual liberty, and bringing management and labor to an understanding of the united effort necessary to advance the common good. If we face these issues, we will find answers which will benefit our own people and provide the world with the lead it is looking for.

This is surely our mission in the world today, and our great challenge.

MANY AMERICANS who profess fear of attack from without seemingly give but little thought to a possible catastrophe fully as grim—the danger that our traditional Freedoms could be given away, or dissipated at home.

Should such a disaster occur, it can only come to pass because the American people do not know what they are forfeiting, or realize how they may be losing their most priceless heritage.

Until we take constructive actions effectively, we shall continue to be in danger of losing, through lack of understanding or belief, those values that have enabled us, as a nation, to accomplish in material ways and in human values, what no other people have so far achieved.

Americans should understand how civil, political, and individual liberties, operating within a competitive economy, result in the most nearly perfect society yet devised. We should emphasize the truth that our competitive economy is the key to productivity; that it is productivity that turns the American dream into the great American reality; that our individual productivity is the measure of the contribution that we all can make to progress, and to the benefits that we, as individuals, may expect to realize.

Our schools can help most. We must mobilize in the field of American education the will and intelligence that is urgently needed if education is to become, as it should be, the major bulwark of our political, social, and economic system. The framework of our Freedoms, within which individual men and women will make their lives in the years to come, is fully as important as the special talents that may be developed through education.

Education should define the framework of our Freedoms, help us reach a generally accepted understanding of our Freedoms so that we value them preciously and are prepared to defend them against all onslaughts, from within or without, throughout our lives. (From an editorial by John Lyon Collier, chairman and president, The B. F. Goodrich Company; one of a series of editorials written for business press by industrial leaders at the instance of National Business Publications, Inc.)

THE RETREAT *From* FREEDOM

By W. C. MULLENDORE

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OVER far too long a period now, we, the people of the United States of America, have been squandering our heritage and blindly following the old, treacherous, but often beguiling, ways which lead backward and downward from the unfrequented heights of liberty to the lowlands of tyranny and despair where the great bulk of mankind has lived for practically the whole of human history. Despite frequent repetition of the warning that "eternal vigilance is the price of liberty," we, the people, have followed false and incompetent leaders as they have increasingly succumbed to the ancient temptations to seek power and fleeting glory by bribing the people, with the people's own wealth, to acquiesce in the expansion and misuse of the powers of government at home and abroad.

Thus beguiled and misled, during the first half of the twentieth century, we have traveled far into the soul-destroying land of Socialism, and made strange alliances through which we have become involved in almost continuous hot and cold wars over the whole of the earth. In this retreat from freedom, the voices of protesting citizens have been drowned by raucous shouts of intolerance and abuse from those who led the retreat and their millions of gullible dupes, who are marching merrily to their doom, carrying banners on which are emblazoned such intriguing and misapplied labels as "social justice," "equality," "reform," "patriotism," and "social welfare."

Many of those who have tried to sound the alarm and have warned that this road of retreat from freedom leads to disaster, have become discouraged in the face of the ridicule and abuse with which their warnings have been met. They have been labeled as reactionary, pessimists, prophets of doom, "mossbacks," and with many other derogatory names and phrases, all intended to brand them as blind, and stupid, and selfish enemies of progress. The American traditions of optimism and pioneering courage have been called upon by the leaders of the retreat, to justify their assurances that this is "only a period of dynamic change for the better"; that "it is only the timid and nearsighted who are afraid of such changes"; that "in such periods there are always a few who falsely cry 'crisis,' and prophesy disaster, but that always they have been proved wrong." From the vantage point of the highest governmental offices in the Nation, and even from many prominent business, educational, and religious leaders, we hear that, for the U. S. A. at least, this is indeed a time of progress and of greatest prosperity, that our country was never so strong, and that the fears of excessive commitments abroad, of inflation, of big spending, of unprecedented debt, and unbearable taxes are but bugaboos brought forward by those lacking in understanding, vision, and foresight.

Why speak about it here? Because most of us must admit that we are of the great group of responsible citizens who have either kept silent, or have joined in some measure of endorsement of this period of inflation and liquidation of the nation's wealth—this period in which the moral and spiritual foundations of our strength are disintegrating. Some of us must admit to being among those who have helped to create the impression that the present is a period of sound growth and prosperity. Some of us, at least, continue to applaud the meaningless phrase "We have nothing to fear but fear," while we fear the blustering Russians; fear to face the truth about the source of our false prosperity; and fear to question the fateful conclusion that it is the duty and responsibility of our country to play the impossibly exaggerated role which we are attempting to play in the affairs of other peoples throughout the world.

Responsibility of free men in a republic is measured by and proportionate to opportunity and position of influence and leadership. For the most part, we of the business and professional world, whether lawyers, engineers, teachers, ministers, doctors, or business managers and owners, have failed to live up to the required level of responsibility of citizenship in our onetime Republic. We have failed both actively and passively. By our attitude that all is well, and by an apparent unconcern and lack of awareness, we have misled others, who had a right to rely upon our judgment and leadership. We were the sentries on duty and the attack came in force on our sector of the front, but we have failed to sound the alarm. We have fought a little here and there, but for the most part we have fallen back in confusion, fraternized with the enemy, and busied ourselves with other matters than the great issue of the day—*collectivism and slavery versus individualism and liberty*.

Engineers have a special responsibility because their training and experience teaches them the importance of fixed principles and immutable laws, and the dangers flowing from ignoring and disobeying them. Engineers and scientists are fully aware that in the physical world there is an eternal conflict between forces which integrate and forces which disintegrate. Man's discoveries and achievements in the physical world, of which we boast and in which we take justified pride—the continued implementation of newly discovered truths about the nature of matter and the laws which control it—these great achievements, were dependent upon complying with the laws which integrate the constructive forces, and successfully combat and hold in check the forces which destroy and disintegrate.

The engineer, therefore, should be specially qualified to understand and to help others to understand the great fundamental which is being ignored in human affairs today, viz., that there are similar fixed and unchanging principles governing human nature and human relations in life on this planet. The forces of human nature, like those of the physical world, may be divided into those which are integrating and those which are disintegrating. Human intelligence, instinct, emotion, and action may be either constructive and creative, may be so directed and controlled that they will help to integrate and to build a better life, or they can be destructive and disintegrating, even to the extent of destroying the spiritual and intangible as well as the physical foundations of a great civilization.

Jose Ortega y Gasset, the great modern Spanish philosopher, has forcefully pointed out the peril of overconfidence and of ignoring these great fundamental moral and spiritual laws, saying:

> I wish it would dawn upon engineers that, in order to be an engineer, it is not enough to be an engineer. While they are minding their own business, history may be pulling the ground from under their feet.
>
> People believe modern technology more firmly established in history than all previous technologies because of its scientific foundations. But this alleged security is illusory.
>
> Indeed, it is just this feeling of security which is endangering Western

Text of the Roy V. Wright Memorial Lecture delivered at the Annual Meeting, Atlantic City, N. J., Nov. 25–30, 1951, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

civilization. The belief in progress, the conviction that on this level of history a major setback can no longer happen and the world will go the full length of prosperity, has loosened the rivets of human caution and flung open the gates for a new invasion of barbarism.

Ortega has thus dramatically stated the point. We are too sure of ourselves, too complacent in a time of great danger. We are placing too much reliance upon our technical skill, our command over natural physical forces and energy, and our matchless ability to produce. Intoxicated with pride in our achievement, immersed in the interesting problems still unsolved, we have left unguarded the gates through which are pouring the destructive hordes and forces of a "new invasion of barbarism."

The laws, the fixed and basic principles governing the development and growth of the human individual and his society are as old as civilization. Indeed at least some of these principles had to be discovered and practiced before man could start on his long march away from his status as a predatory animal and toward that still distant goal of human perfection. These unchanging moral and spiritual laws, designed by the Creator, discovered by inspired and devout leaders of mankind, and stated and restated for man's guidance, include, of course, the fixed moral laws of the Ten Commandments, the Golden Rule, and the Sermon on the Mount. They also include the great social and political principles stated and restated through the ages by political philosophers from Hammurabi in ancient Babylonia, Polybius, Socrates, and Aristotle in ancient Greece, down to the present day.

In our distinctively American principles, we lay great stress upon definite limitations of the powers of government. "All men are endowed by their Creator," says the Declaration of Independence, "with certain unalienable rights, that among these are *Life*, *Liberty*, and *the pursuit of Happiness*," and, says, the Declaration, "That to *secure* these rights, Governments are instituted among men, deriving their just powers from the consent of the governed." To make it quite certain that the world would not misunderstand their position with respect to a government which attempted to infringe upon these rights, the authors of the Declaration further said: "Whenever any form of Government becomes destructive of these ends, it is the right of the people to alter or abolish it, and to institute new Government . . ."

Those who fail to resist the acts of a government which are destructive of the unalienable rights set forth in our Declaration of Independence and in the Bill of Rights of the Constitution are failing in their duty as citizens and as men. By such failure they are contributing to the loosing of the disintegrating forces which will destroy our spiritual and political heritage, and deprive our children of their rights, and failing just as surely as would the engineer if he ignored the disintegrating and destructive forces which he is required to combat in the course of his professional duties.

THE AMERICAN WAY

The fundamental of fundamentals of the plan for living in these United States, which has become known as the American way of life, was an *economically independent* citizenry supporting and controlling a government so limited and confined by a written constitution that the age-old revolutionary trick of reversing this situation and enslaving the people by having government support the people, thus making them dependent upon government, could never be pulled in America. But in thus reckoning and planning, there was a failure to take into account some of the loopholes in that Constitution, as well as the power of the demagogue, assisted by the resourcefulness of the frustrated intellectuals in a period of depression and war.

We are now alerted against Communism, but we are not alerted against, and as a people, or in our international role of leader, we are not condemning the heart of the Communist doctrine, which is Socialism. We are against Communist methods; we don't like Communist manners or Communist threats of violence. But for many years now we hav been very hospitable to the economic program of Karl Marx, the father of Socialism and the founder of Communism. Politically the majority of our people have voted more than once, and in their attitude toward the expanding powers of government they have repeatedly acted in such a manner as to indicate approval of large doses of Socialism, and of the doctrines of the Communist Manifesto of Karl Marx and Friedrich Engels.

That is a serious charge and we should be prepared to prove it specifically. Well, here are some facts:

INROADS OF COMMUNISM

First Point: The Communist Manifesto advocated a heavy progressive or graduated income tax. That we have had and have used even to the extent that some citizens have to work 85 to 90 days out of each hundred for the government. Many others work 50 to 60 days out of each hundred, while, of course, there are still larger numbers who *directly* pay but little tax or who actually receive more from the government treasury than they pay into it. Thus are the more productive and more competent penalized, in accord with the Marxian thesis.

Second Point: Marx said the right of inheritance should be abolished. We are getting around to that but, thus far again, government taking of from 50 to 90 per cent of the deceased's estate happens only to the larger estates.

Third Point: Marx advocated centralization of credit in the hands of the state, with the state exercising a monopoly on capital and credit. Well, the Federal Government of the United States has gone a long way toward this goal. Through Government lending to great groups—to the veteran, the businessman, to the home builder, the farmer—and through control over both the amount of and price for credit, our Government has taken the most important steps toward attainment of this goal.

Furthermore, in this category of expansion of the dangerous powers of government, we have become the victim of the economic disease upon which Lenin and Marx relied most confidently for the destruction of capitalism. This disease is inflation, which, by eroding away the savings of the people and by encouraging extravagant public and private spending, creates a false and phony prosperity which inevitably leads to an economic reaction of great severity and, thence, to the insecurity and fear which causes people to trade their remaining liberty for a promise of government guardianship, i.e., dictatorship. This has happened repeatedly in European countries and in China in recent years and is now happening in England and in the U. S. A.

Fourth Point: Marx advocated extension of Government ownership and operation of the instruments of production; the bringing into cultivation of wastelands, and improvement of soil generally, under government programs of control and direction. We have complete government ownership of power systems in the TVA, as well as in the State of Nebraska, and Government ownership and development of power is spreading rapidly not only in the Northwest, but in the Southwest and through the REA in many other sections. Government, likewise, is pushing forward in every field of business enterprise, from amusement and agriculture on through the alphabet—always as the unfair, tax-exempt competitor, utilizing the police powers and other forces of government, to confiscate the property of its citizen-competitors, and to deprive them

of their means of livelihood—always resorting to the specious and wholly false Socialist argument that Government represents all the people and that the private citizen must give way before this "broader and more beneficent" interest.

Fifth Point: Marx specifically advocated the "abolition of property in land." We have not yet suffered the complete denial of that right, but, under rent control, and under the powers exercised over the use of agricultural and other land by the Departments of Agriculture and Interior, great inroads have been and are being made upon the rights of private ownership in real property.

Sixth Point: Marx advocated the centralization in government of the means of communication and transportation. Again, we find that government controls over radio, television, telephone, the postal system, the railroads, and other means of transport go far beyond mere necessary regulation and include many of the powers arbitrarily to manage and direct agencies by which the citizens carry on the exchange of goods, services, and information.

Seventh Point: Marx holds that the individual is unimportant and the state or "society" is all-important; that the end and aim of life is the development of the collective and not the individual. While we still pay lip service to our respect for the individual, and while our "liberals" profess an ever-increased devotion to the so-called civil rights of the individual, yet, both the domestic and international policies which are presently followed and vociferously defended by the "liberals," in government and out, subordinate the individual to the group, and to "society." Our labor laws and the government-supported policies of labor unions, our tax laws, social-security programs, housing and rent control, and co-operative laws, and many others, clearly subordinate the life, liberty, and property of the individual to that of the majority, or to those exercising power claimed to have been conferred by the majority.

In international affairs, the individual citizen's life, liberty, and property have been subjected to a vastly enlarged and badly defined treaty-making power, and to the power of individuals within the executive branch of Government who claim and exercise the authority to make commitments to foreign governments. These treaties, and sometimes secret commitments, lead to irresistible orders that millions of our young men shall, without the right to choose, or even to argue their case, leave their homes and families and offer their lives and their all, upon the altar of any cause which may be defined by these all-powerful international policy makers.

Thus there has been fashioned for the American of today a new kind of imperialism—the imperialism of the international "do-gooders"—a small but vocal and very powerfully placed minority who have both discovered and defined a new role of world-leadership for all the citizens of the United States of America. No one has ever asked the American people, who must bear the burdens, whether they accept this role of "do-gooder imperialism." The foreign policy makers have merely assured us that in their wisdom they have discovered that the mantle of leadership has fallen upon our shoulders, and that they, the policy makers, will make the decisions and will interpret for us the obligations which have resulted therefrom.

Within the memory of most of us, it was one of the proudest boasts of the American citizen that he was free from the terrible tyranny of the supreme military policy and force, such as existed under the flag of foreign imperial powers. We felt secure against powers under which the citizen could be drafted into military service and sent throughout the world to carry the flag of empire, and to do the bidding of the policy makers of the foreign offices or chancellories, which exercised this power of life and death over the helpless subjects in the name of king or emperor, and for the glory of the empire. But no longer can we boast. No longer can we tell our sons, as our fathers told us, that they are free from such arbitrary and sudden decisions of foreign offices. Indeed, we must now admit to them that under treaties recently entered into, decisions made in the foreign offices of any one of almost a score of other nations may result in their being ordered to other Koreas around the world.

WORLD WARS II AND III

In violation of the most solemn promises made "again and again" by the President to the people in the political campaign of 1940, we were involved in World War II. The desperate course, which led to our involvement without the consent of our people, was taken, despite the warning so frequently uttered beforehand, that such action would lead to the destruction of our civilization and the American way of life.

In that war, there was poured out the lifeblood of hundreds of American young men upon the altar of a war which they won, but which was lost at the conference tables by the weak, foolish, and incompetent leaders who maneuvered us into it; and as we now know, there was thus prepared for us the terrible and impossible mess in which we are now involved.

Now, after those impoverishing years of war, we have had six years of the most dangerous and debilitating boom, by far, from which our country has ever suffered. It has been financed and fed by the worst inflation in our history—an inflation which has long since been out of control and which threatens to complete the job, already more than half done, of destroying the American dollar.

Thus we have prepared for the greatest test of strength which we have ever faced. Today, as a result of our own mistaken policies which made Russia a world power, we are facing, not necessarily the strongest, but certainly the most ruthless and brutal enemy of civilization of all time. We have undertaken not only to lead, but to build up and equip the armed forces of, a score or more of nations, having a total population of several hundred millions of more or less impoverished people, and scattered on every continent of the globe.

And how have these 154 million citizens of the United States of America been prepared for this greatest burden ever carried and greatest struggle ever faced in human history? Have they carefully renewed their devotion to the basic truths, ideals, and free institutions from which their strength was derived? Have they rigorously taught and practiced the strengthening virtues of self-reliance, self-discipline, and self-denial? Have they husbanded their resources, denied themselves every extravagance, forced their Government to economize, reduced their public and private debts, learned to work harder and longer hours, and generally done everything possible to strengthen both their physical and their moral fiber? Have their leaders in government, in business, and in the spiritual and educational realms, helped to prepare them by explaining to them, clearly and forcefully, the terrible ordeal which lies ahead and which they must endure over an indefinite but very long period of years?

You know the answer. It can be summed up in the statement that in every important respect we, the American people, and our Government, have done just the opposite of that which we should have done to prepare ourselves for those unlimited world-wide commitments and immeasurable burdens to which our leaders have so recklessly, and with such wild abandon, committed us.

If we could escape the penalty for this foolish and ignorant course of conduct by ignoring the facts; if we could make ourselves strong and ready and prepared for this prolonged life and death struggle by wishful thinking and foolish boasting about our great productive capacity, our "wonderful" national income, and the number of automobiles and houses and gadgets

which we buy, the money we spend, and the height of our standard of living as compared with the rest of the world, then we might forgive the constantly reiterated emphasis upon these misinterpreted facts. If all these soothing statistics in which we are immersed and with which we meet the expressions of concern from the so-called alarmists—if the inroads of Russian communism can be overcome, and our allies armed and fed with these statistics,—then let us by all means continue to hold them before our eyes, and to talk about them in the marts of trade, to the exclusion of all else, as we have been doing. But if this is building a fatally false confidence in our strength, when we are in fact weakening the source of our real strength, then we should insist on the hard truth from our leadership, rather than dangerously soft fiction!

Yes, the adherents of Karl Marx can embarass us by asking: Just how much is left of your boasted individual sovereignty? How much farther must you go before your citizen is transformed into a subject? And to those who, in reply to these criticisms of our foreign policy, hurl the epithet "Isolationism," let us reply that we are advocating a policy which places the freedom of the American citizen and the conservation of the vital strength of our country above the claims arising out of the age-old quarrels and decadent policies of foreign nations. Our first duty is not to those suffering from the results of centuries of misguidance and tyranny, for which we are not responsible and from which our forefathers fled, but rather our first duty is to preserve the hope and opportunity for the individual American citizen which are dependent upon the free institutions of our own country. We cannot save others by tearing ourselves down. We cannot advance the cause of human freedom and progress by recklessly overcommitting ourselves to carry the burdens imposed upon foreign nations by the accumulated errors of centuries. And if this be Isolationism, then we should be proud indeed to bear the name!"

WHERE HAVE WE ARRIVED?

Where has this long and confused retreat from freedom taken us? Obviously, we have already become entangled in the toils of a Socialist State. We have gone too far, and we are very dangerously involved because as a people we have already taken so much "dope" from the Socialist bottle (both nationally and internationally) that we no longer can think straight. Indeed, in connection with the recent revelations of the undermining of integrity in America by the criminal element, I wonder that it does not occur to our people that government itself has become a "dope peddler" on a gigantic scale.

The "dope" peddled by government agents and agencies has been and is depriving Americans by the millions of their most precious spiritual heritage, including self-reliance, self-discipline, initiative, independence, and self-respect. We properly condemn and execrate those who peddle "dope" to the children and others, which cripple their mentalities, undermine their health, and enslave them to a drug. What shall we say of those who, under the guise of humanitarian reform, and with all the prestige and power of government back of them, rob the American citizen of his integrity and encourage him to use not only false statements and misrepresentation but force, threats, and terroristic methods to obtain from his neighbors, employers, or the community generally that which he did not earn and to which he has no rightful claim, moral or otherwise. Good citizens are thus being debauched, corrupted, and demoralized, and the nation is thereby losing strength which is sorely needed in this testing period of trouble and crisis.

The creative urge, implanted by God in all normal human beings, thrives under liberty. Liberty is possible only when individuals are self-reliant, self-disciplined, and so conduct themselves toward each other that there is a *mutual* respect for, and encouragement of, those qualities and forces in human nature which stimulate growth and development of the best of which man is capable. Felix Morley states the American fundamental concisely and accurately in "The Power in the People" (p. 14) when he says:

"When the American people have been self-reliant, mutually helpful and considerate, determined in their mistrust of political authority, this nation has been 'in form'; its tradition alive; its contribution to civilization outstanding."

Increasingly, over the first half of the twentieth century, we have been getting "out of form," lazily drifting with the erratic tides of popular unrest, stirred up and stimulated by the boll weevil of democracy—the demagogue. The vast numbers who have been imposing their burdens upon their fellow citizens, without giving in exchange either consideration or gratitude, have included the strong and able-bodied as well as the weak. Under the banner of the weak and underprivileged, and in the name of social justice and reform, the political power of millions has been marshalled by and under bad leaders for the purpose of plundering their neighbors.

The appetite for living at the expense of one's fellow citizen grows by what it feeds upon. When the moral sense is corrupted by bribes collected through unlimited income taxes, and distributed through the public treasury, it becomes increasingly easy to rationalize contributions forced from one's neighbors to support oneself in idleness as "social-security benefits." It is also easy to convince oneself that one has earned the handout by merely living, and contriving to comply with the liberal qualifications, rules, and regulations administered by bureaucrats who look upon the beneficiaries as "clients" whose growing numbers add to the importance and security of the job of the dispenser of "social security."

Thus, a dangerous disintegrating force of human nature—one which feeds upon and destroys the very basis of freedom, which is *self-reliance*—grows and devitalizes the initiative and creative urge of millions of individuals, even while production and consumption may appear to be flourishing because of the false stimulation of the inflation which is resorted to as a means of financing the earlier stages of the growth of a Socialized State.

Where then are we now, and where do we go from here? We may summarize our present situation in this way: We have fought in two world wars in the past 35 years. We have sacrificed hundreds of thousands of lives and incurred obligations against our future earnings equal to the savings which we have accumulated throughout our history as an independent nation. Nor is that by any means all. We are now burdened with the protection and leadership of half the world in an undeclared war against the other half. The American people have no aptitude, genius, or desire for such responsibilities but we have stumbled and fumbled our confused way into this illogical inconsistent and terrifying position of leadership of hundreds of millions of other peoples whom we do not understand and who do not understand us, and whose ideas and ideals are quite different from ours. Before, during, and since our involvement in World War II, the same destructive foreign ideologies of collectivism and totalitarianism which enslaved Russia, destroyed Europe, and have now engulfed Great Britain, have been flowing in upon us and making distinct headway in destroying and supplanting those distinctive American institutions of freedom which were and are the source and secret of our strength. Over the past 18 years in particular, we have been increasingly abandoning the new, modern, liberal American system of limited Federal, republican government, and substituting therefor the reactionary old-world plan of a centralized paternalistic government, with its creeping paralysis of individual initiative, self-reliance, and of other integrating

forces indispensable to the strength and upbuilding of the individual human character.

Where Do We Go From Here? What do we do about it? Obviously, now that we have wandered so far, and for such a long period, in this unfamiliar and uncongenial territory into which we have been led by false and incompetent leaders, we will find the return trip to the right—the American—road a very rough and trying one. We will find no magic carpet to take us there. We cannot get there by merely voting once each year or so and then going about our business as usual. We must each as individuals wake up, and live up to our responsibility as free citizens who are determined to regain their freedom. We cannot leave the job to politicians of any party. We must make it our job in our daily life, in the home, the office, or the school and college, the church, or wherever we have influence and can be heard. We must accept the fact that the return trip to a land of free men will be both dangerous and discouraging at times. But we must start on it—not only get going, but keep going. Otherwise all our great physical progress, our great works, our productive potential, our standard of living, our comfort and abundance will go down, because, without the prompt restoration of the spiritual foundations of our material achievements, *all will be lost.*

I am not proposing that we should all take a leave of absence from our jobs and take to the hustings for the purpose of sounding the alarm about the imminent danger to our basic institutions. Of course, we have important work to do and we must keep at it. I am saying, however, that regardless of our devotion to the means by which we earn our livelihood, we also have a paramount responsibility to ourselves and our children to preserve the foundations and the framework of this house within which we live. Along with our responsibility for our daily work, we have an even higher or primary responsibility of doing what we reasonably can to ward off and defeat those forces which are now forging chains of governmental power and authority to further restrict and regiment the lives of our children.

I am concerned lest it be said of us by our children that when their heritage was being destroyed, their fathers, notwithstanding their education and opportunity to know the facts, were so busy with their electrons and formulas, with their great engineering projects and perfection of television and gadgets, that they had no time to help in the preservation of the fundamental liberties without which the whole of that heritage will be lost.

I am unwilling to believe that we of this generation of business leaders are so uninformed and so unaware, so recreant indeed to our first duty as free American citizens, that we will merely resign ourselves, and the destiny of our country, to this tragedy toward which we are now headed. We do not know that we can, in our day, regain the freedom and independence which America once knew, but there is an enormous latent and potential strength in our love of country, our aspiration for freedom of opportunity for our children, and our respect for the wisdom of the founding fathers.

Finally, and most important of all, the American people must revive and renew faith in a just and righteous God, and in the promise of Jesus Christ that "if you continue in my word, . . . ye shall know the truth, and the truth shall make you free." But, note carefully, my friends, that the promise of the Master was conditioned upon our continuing in His word—that is, upon following the true, the right road. And thus far *we are continuing upon that wrong road which we took many long years ago!*

A $65 Question: What's It Like in "Heaven"

(Continued from page 118)

Concept of Constructive Union-Management Relations." After asking themselves, "What type of accommodation between companies and unions is 'best'?" the authors clear the ground for a statement of their own views by dismissing two fears that haunted many minds a decade ago. The first of these is the view that collective bargaining imposes on the economy an unhealthy distortion of the price system. There is increasing factual evidence, Harbison and Coleman report, that this is simply not true. Many economists are beginning to feel that today's wage levels would have been reached even without large-scale unionization. The second bogey that no longer deserves to be taken seriously is the unspoken fear of the 1930's that Big Unionism in the mass-production industries would lead to the revolutionary overthrow of free enterprise capitalism. Today, many businessmen and most union leaders regard collective bargaining as an essentially conservative force. "Collective bargaining," the authors say, "may perform a positive function in humanizing the price system and in broadening the base of popular support for capitalism." But even more important to the authors is the fact that collective bargaining supplies a new outlet for realizing "the commonly held goals of a free society." Harbison and Coleman see these goals as follows: (1) The enhancement of the dignity, worth, and freedom of the individual, (2) the preservation and strengthening of democratic institutions within which the individual finds expression; and (3) economic progress "shared by all men." The kinds of specific things these general goals imply are briefly suggested.

Having made their criteria explicit (the criteria are not, in fact, *their* criteria but their estimate of *society's* goals), the authors suggest that the main contribution of collective bargaining toward the achievement of these goals lies in the field of "protecting and enhancing individual rights and freedoms on the job." A union performs this function not only by challenging and regulating managerial action but also by stimulating employers to take steps—often outside the arena of union-management relations—for the enhancement of individual freedom and for the greater recognition of human values. The whole structure of "personnel administration," for example, can be viewed, in many situations, as a company response to union pressures which enhances the freedom and dignity of the individual employee. If this view is accepted, then "collective bargaining is much more than a process of peaceful compromise of differences. . . . It should command not the mere tolerance but the unfaltering support of all persons who want to preserve a working relationship between capitalism and democracy."

Here is an ultimate act of faith that not everyone in management will be able to duplicate; and certainly Harbison and Coleman know too much about the facts of life to hang a halo over every individual bargaining relationship. Nor have they tried to anticipate their critics by grappling with the objections that might be entered against their point of view. But they have approached a difficult highly charged subject with a humble respect for facts, with a light pen free of all academic gobbledygook, and with a sense of responsibility which makes their final conclusion both helpful and hopeful. All the book needs to win the notice it deserves is the further discussion which its authors set out to provoke.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Technical Editor*

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

567 Series Diesel Engine

IN a paper which he presented before a Railroad Division Technical Session during the 1951 ASME Annual Meeting, in Atlantic City, N. J., E. W. Kettering, chief engineer of the Electro-Motive Division of General Motors Corporation, LaGrange, Ill., related the history and development of the 567 Series General Motors locomotive engine.

Before going into the 567 design, Mr. Kettering gave some background material on the use of gasoline engines and early Diesels by the railroads. He also presented some facts on G-M's Model 201 and 201A Diesels—predecessors of the 567 Series.

In developing the G-M 567 Series locomotive Diesel engine, it was decided that the new engine should be physically as large as possible to fit into the car body structure of the locomotive, still keeping in mind, however, that the engine had to be maintained. The pistons, cylinder heads, cylinder liners, connecting rods, etc., should be small and light enough to be handled within a locomotive without the use of mechanical lifting devices, and the scavenging blowers, water pumps, oil pumps, governor, etc., should be readily accessible for removal within the locomotive. It should have ease of inspection of pistons, liners, etc., as well as easy removal of all wearing parts.

It was readily apparent that a relatively narrow V-type 2-cycle engine would be the most compact to fill the requirements for a locomotive engine. The original plans called for 8 and 12-cylinder engines with a later possibility of 6 and 16-cylinder models. One of the early difficult problems was calculation of the torsional characteristics in the crankshaft, and the over-all balance of each of the four engines plus the development of a firing order which would give the best conditions in each engine. This analysis was adequate as only one harmonic balancer is necessary for all engines except the 6-cylinder which does not need a balancer.

It was found that the degree of torsional vibration is not sufficient to cause shaft, bearing, or gear-train difficulties. It was also noted that the maximum amplitude of torsional vibration does not occur at any governed speed. It is of interest to note that the maximum order of vibration for each engine (number of twists per crankshaft revolution) is the same as the number of crankpins.

The full line of engines was designed with the same general arrangement, revising basically only the length of crankshaft and crankcase to accommodate the required number of cylinders. It appeared that the most satisfactory method of having the engine accessories such as pumps, governor, etc., easily maintained would be to drive them through a gear train at the forward end of the engine, that is, opposite the power take-off end. Having the location of the pumps all at one end of the engine, called the accessory drive end, fitted very well into locomotive installation. A leaf-spring flexible drive gear mounted on the crankshaft was used to eliminate all crankshaft torsional vibration from the gear train.

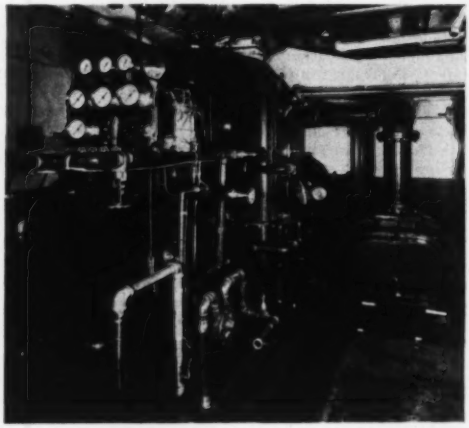

FIG. 1 ORIGINAL GENERAL MOTORS TWO-CYLINDER SERIES 56 TEST-ENGINE SETUP

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources: i.e. (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

By using either one or two blowers for an 8 or 12-cylinder engine, respectively, and mounting them above the main generator, it was possible to shorten the over-all length of the engine and generator installation. This was one of the main original objectives. The blowers as well as the camshafts were driven at the power take-off end of the engine by another gear train.

It was very important that all accessories be designed in such a way that at least the tooling could be common for all. It was for this basic reason that the oil pumps were designed alike except for pump gear length. The water pumps were designed so that either one or two pumps could be used. The blower design was based on using two blowers for the 12-cylinder, the same two blowers for the 16 with increased speed, and one blower for the 6 and 8. Also the accessory end housings were identical, and by having the drive gears mounted directly on the accessories, interchangeability as well as simple tooling could be accomplished. The camshaft was designed in sections to allow minimum tooling and ease of replacement. The crankshafts were all identical with the exception of length, allowing the use of the same bearings.

This same philosophy, in general, was used throughout the design. Because of the prospect of reasonably complete tooling, much more effort was put on this design in an endeavor to simplify machining and eliminate as much unnecessary handwork as possible.

In order to develop power assemblies of the multicylinder engine as well as get more background on the combustion characteristics of the engine, a 2-cylinder 45-deg V 567 engine

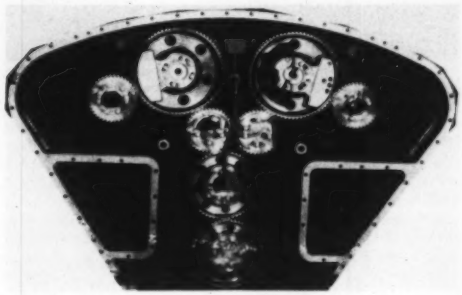

FIG. 2 ORIGINAL DESIGN OF G-M MODEL 567 DIESEL ENGINE GEAR TRAIN

was built. This engine was used to study pistons, rings, and their relation to cylinder liners; piston pins and their related bushings; connecting rods and connecting-rod-bearing design. However, since rod and bearing development alone took so much time, it was necessary to build a second 2-cylinder engine in order to study the piston, liner, head, and combustion.

These 2-cylinder engines were made as nearly as possible to duplicate multicylinder engine parts enabling exact duplication of crankshaft connecting rod, wrist pin, piston, piston rings, cylinder liner, cylinder head valve gear, and camshaft. The remainder of the parts necessary to make the engine run were not common to the multicylinder engines. An attempt, however, was made to develop the intake air distribution (combustion characteristics and exhaust systems) somewhere near that which was produced at a later date on the multicylinder engines. This was vital because 2-cycle engines are extremely sensitive to changes affecting breathing.

With these basic considerations in mind, the complete line of Model 567 engines were started in the early fall of 1936. As the design progressed the more detailed components of the engine were developed.

These new railroad engines were rated at 800 rpm and 80 bmep and put in production in 1938. The 16-cylinder engine was installed in 1350-hp freight units and two 12-cylinder engines in 2000-hp passenger units. Based on field experience it was felt that the engine rating could be increased, so in 1947 the bmep was raised to 92 or 1500 hp on a 16-cylinder engine. Engines at the increased rating are installed in 1500-hp freight units and 2250-hp passenger units. In 1948 a new cooling system was designed for the 12-cylinder switcher, allowing its rating to be increased to 1200 hp, thus making it the same as the 6 and 8-cylinder.

BLOWER DRIVE GEAR TRAIN

In 1941 a complete redesign of the gear train was made and incorporated in what became known as the 567A engine. In this redesign the blowers were moved inward, which reduced the maximum width of the engine, the camshaft centers being held the same. The number of idler gears between crankshaft and camshaft was reduced from four to two. The redesign used straight spur gears as were used in the last modification of the first engine design. It incorporated the use of floating bushings rather than pressed-in bushings. In actual service the new design has shown about a 4 to 1 improvement, that is, 8 years versus 2 years on the 16-cylinder engine.

The 567B gear train is identical to that of the A except that the stub shaft for the two idlers is one piece rather than two separate stub shafts, the oil being fed to the gears through cored passages rather than through externally mounted oil lines. This was done because some trouble was encountered with breakage of the A gear train oil lines due to extremely high-frequency low-amplitude vibrations. Also, in the B gear train was incorporated a wider upper idler in order to drive the auxiliary generator drive gear—thus the upper idler drives both a camshaft gear and an auxiliary generator drive gear.

CRANKCASE

A new crankcase was developed and went into production early in 1940 using a fabricated top deck. This design simplified top-deck machining, eliminated the studding of the cast top deck by replacing the studs with through bolts retained by crabs at the bottom of the pots and crabs at the top of the cylinder heads, using self-aligning spherical washers and nuts.

By 1941 it was desirable to further simplify the crankcase, and

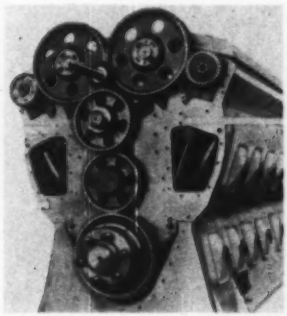

FIG. 3 REDESIGNED GEAR TRAIN USED IN MODEL 567A AND B G-M DIESEL ENGINES

the flat top deck Model 567A crankcase was developed. This crankcase was first used on the 12-cylinder LST engines which started in production early in 1942. The crankcase incorporated a flat tie plate the full length of the engine. This provided a flat surface for mounting exhaust manifolds and lift hooks. It was at this time that the gear train was simplified from four to two idler gears.

In 1946 a new line of crankcases, designated as the 567B,

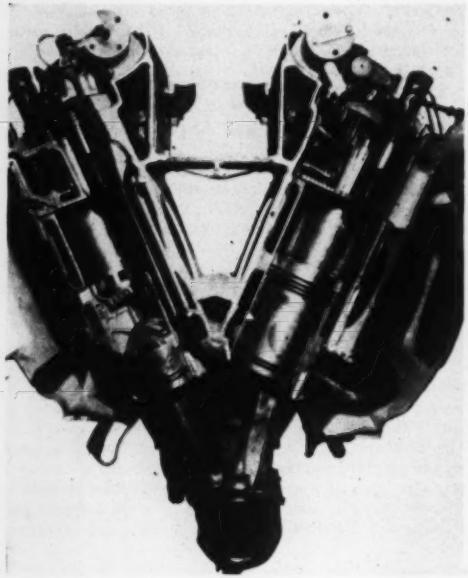

FIG. 4 SECTION THROUGH MODEL 567 DIESEL ENGINE

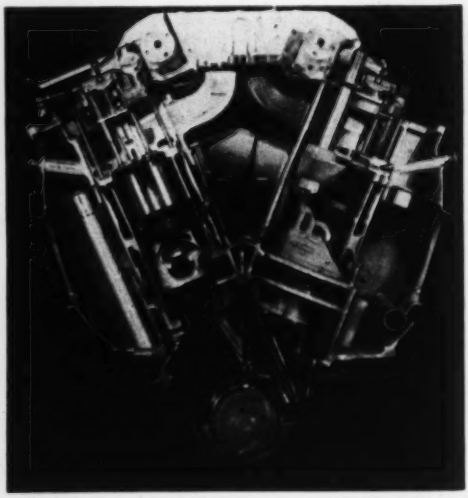

FIG. 5 SECTION THROUGH CURRENT MODEL 567B ENGINE

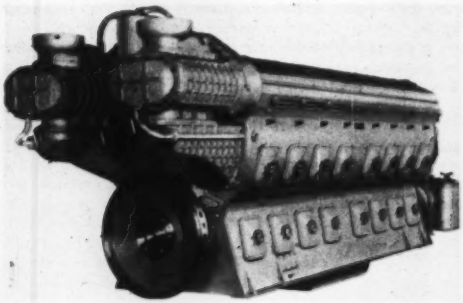

FIG. 6 EXTERIOR VIEW OF G-M'S MODEL 567B 16-CYLINDER LOCOMOTIVE DIESEL ENGINE

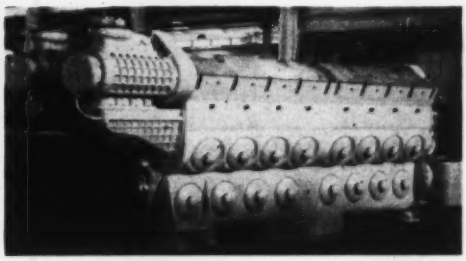

FIG. 7 EXTERIOR VIEW OF NEWLY DEVELOPED MODEL 567C 16-CYLINDER DIESEL ENGINE

FIG. 8 NEWLY DESIGNED PISTON-PIN CARRIER AND WRIST PIN

were introduced which were basically the same as the 567A except for a change to permit the mounting of the auxiliary generator drive gear. About three or four months after the introduction of the B engine the cylinder-head retainer castings, which had been a continuous source of production problems, were replaced with steel forgings. Whereas both the A and B crankcases calculated to be of very low stress value in their main structures, minor fatigue cracks have appeared in field service. The complexity of a structure of this type is such that it cannot be fully calculated so that in 1947 and 1948,

after development of SR-4 stress gages, the crankcase structures were stress-analyzed both statically and dynamically. Various corrections were made, such as slight alterations of gussets, and the like, to reduce stress where fatigue cracks occurred. Similar stress analyses and corrections were made to oil pans. A considerable amount of work has been done along these lines so that at the present time in the current B engines it has been impossible to find any stresses in parent metal above 5000 psi. It also has been impossible to find any stresses in welds, where notch effects may act as stress raisers, above 2500 psi.

FUTURE DEVELOPMENTS

GM is now in the final stages of developing a new crankcase to be known as the Model 567C which will further improve the engine. One premise of this design has been to eliminate water on any stressed member of the crankcase because of corrosion difficulties. In earlier crankcases, cracks have occurred in the area of the cooling water which were caused by corrosion fatigue. The elimination of water on the stress members is accomplished by furnishing cooling water to the cylinder liners through a bolted-on manifold and stopping the stress level at the heavy top deck so as to eliminate any stress around the water-cooled exhaust passage. Stress has been further reduced in the basic load-carrying members by increasing weld area and increasing the size of the load-carrying members. The same basic principle of structure is carried out in the C design as in the earlier designs. The entire fabrication has been simplified through the use of heavy rolled sections to make up the main stress members. Complex forgings are used in the top deck in place of the many steel stampings, thereby reducing a tremendous amount of fitting and manual welding. These two items together will not only reduce the amount of manual welding but will permit more accessible manual welding. As this design lends itself well to automatic welding, much manual welding will be eliminated and the product should result in much lower production cost as well as a much lower maintenance cost.

A maximum amount of interchangeability has been obtained in the C engine as the engine actually requires only new cylinder liners and cylinder head. Since liners and heads are expendable items it is not considered that this will affect interchangeability to any degree. Several other new items have been added to the C engine such as a reduction of gasketed joints and therefore a reduction of oil leaks on the generator end of the engine, as well as a changed cylinder-head frame and cover and fuel transfer lines. These items, however, are applicable to B engines and therefore can be used for improvements on existing B engines. The engine also has a changed oil pan to crankcase joint which uses the metal-to-metal principle of bolting crankcase and oil pan together and sealing by use of a silicone round seal in a square groove. This type of construction is also applicable to A and B engines and is currently being released for the B engine.

Another development is a newly designed piston-pin carrier and wrist pin, called the trunnion carrier and piston. The design involves a forged-steel carrier, oil-hardened, in which floats a silver-plated piston pin, the bearing material being on the piston pin. The piston pin is lubricated by means of grooves. The connecting rod is bolted to the pin and the whole carrier is retained in the piston by means of a snap ring. This design has undergone laboratory test and is now undergoing field test. The area of the wrist-pin bearing is increased from 10 sq in. to 22 sq in., which should greatly extend the life of this assembly. The entire assembly, that is, piston, piston pin, carrier, and connecting rod, is interchangeable in any 567 engine ever built.

In fact, from the first 567 engine built in 1938 through the current Model 567B engine in 1951, GM has not only increased durability and reliability, but to a great degree has maintained interchangeability. All the pieces from a given model of 567B design can be used in any 567 engine that was ever built with the exception of the camshaft-blower drive gear change which was made in 1941. This means that current items such as crankshafts, camshafts, main bearings, connecting-rod bearings, wrist pins, pistons, cylinder heads, cylinder liners, connecting rods, water pumps, oil pumps, etc., can be used in any model crankcase. Further, any current engine including the C engine can be used in any 567 locomotive model that was ever built.

Lightweight Diesel Engine

AN engine has been designed and built by the Cleveland Diesel Engine Division of the General Motors Corporation to meet the Navy's requirement for a lightweight, compact, moderately high-output Diesel generator set for main propulsion of snorkel-type submarines, according to the CADO *Technical Data Digest* for November, 1951. It is a modification of the "Pancake" engine used in submarine chasers during World War II.

The model departs from the conventional in several respects. The crankshaft is vertical and the 16 cylinders are arranged in four banks of four cylinders each. The generator is mounted directly below the engine. The connecting-rod bearings are of the slipper-pad type, and the four rod bearings in each horizontal layer are held against the crankpin by a pair of retainer rings.

Another unusual feature is the use of silver for the bearing surfaces of the connecting rods, wrist-pin bushings, retainer rings, and main bearings.

The new Diesel develops twice the horsepower per pound weight of any comparable propulsion plant used during World War II, and occupies one third less space. The saving in space provides additional room for fuel, torpedoes, and electronic equipment. The increase in a ship's fuel capacity naturally permits greater operating range.

Engineering development to improve performance is continuing under the direction of the Bureau of Ships at the U. S. Naval Engineering Experiment Station, Annapolis, Md., and at the General Motors Corporation.

National Science Foundation

THE $3,500,000 appropriation for the National Science Foundation in the Supplementary Appropriation Act of 1952, signed by the President, will enable the Foundation to start immediately on its two major operating programs—support of basic research in the sciences and training of scientific manpower. Up to now the Foundation has been concerned primarily with planning and with the problems of organization and staffing prior to beginning its operating program.

The reduction in the appropriation from the President's budget request of $14,000,000 for fiscal 1952 has required material scaling down and adjustment of the program originally presented to the Congress. According to Dr. Alan T. Waterman, director of the Foundation, approximately $1,500,000 of the available funds will be allocated for the support of basic research in biology, medicine, mathematics, the physical sciences, and engineering; about $1,350,000 for the training of scientific manpower; and the balance for development of a national policy for the promotion of basic research and educa-

tion in the sciences, for the wider dissemination of scientific information, and for other services including support of the National Scientific Register, now established in the Office of Education.

Basic scientific research will in most cases be supported by means of research grants. No grants have been made to date, although a considerable number of research proposals have been received from investigators in all parts of the United States. It is expected that many more proposals will be received shortly.

Proposals for research grants will be given preliminary evaluation and review by the Foundation's three research divisions: The Division of Biological Sciences, the Division of Mathematical, Physical and Engineering Sciences, and the Division of Medical Research. Each Division will be assisted in evaluation and review by a Divisional Committee, made up of outstanding scientists in the field, and by expert consultants employed on a part-time basis. Grants will be approved by the Director and the 24-member National Science Board, whose chairman is Dr. James B. Conant, president of Harvard University.

The National Science Foundation Graduate Fellowship program will be directed by the Division of Scientific Personnel and Education under Dr. Harry C. Kelly. Selection of fellows will be made solely on the basis of ability and will be carried on by the National Research Council, which has participated in the selection of fellows for various government and private agencies for many years.

Applications will be considered from students in the natural sciences who have or will have completed their undergraduate work in any accredited college or university. Fellows may attend any accredited nonprofit institution offering graduate studies in science which approves their application for admission.

Underground Gasification

FOUR years of extensive experiments conducted by the Bureau of Mines at Gorgas, Ala., have shown that gases suitable for driving gas turbines and generating steam can be obtained through underground gasification—the burning of unmined coal in place—Secretary of the Interior Oscar L. Chapman announced recently in making public the second detailed report on the project. Further tests may prove the feasibility of producing gases for conversion to synthetic liquid fuels or chemicals, he said.

During one phase of the operation, the report discloses, two gas turbines were installed and operated for approximately 100 hr on combustible gases captured from the burning coal. The energy produced by the turbines in turn was used to compress air and send it back underground to the gasification system. In commercial operations, excess energy would be produced for useful purposes.

The successful experiments, staged jointly by the Bureau of Mines and the Alabama Power Company, were pioneered between January 21 and March 12, 1947, during which time the initial goals in gasification were attained, namely, that coal in place could be burned, and that the burning could be controlled. (See "Underground Gasification," MECHANICAL ENGINEERING, February, 1948, pages 127–135.) The early tests, however, were largely exploratory and much smaller in scope, area, and equipment than the subsequent undertaking which commenced its first operating period on March 18, 1949, and finished its final operating period on February 7, 1951. Thereafter water flooding was started to extinguish the fire.

During the 22 months' continuous operation of the second project a total of 10,485 tons of coal, underlying an area of 83,690 sq ft—or almost two acres—was gasified. There appeared to be no limit to coal areas from which combustible gases could be obtained.

Over a four-month period when 65 per cent of the heating value of the coal consumed in one area was realized, the energy yield was greater than could have been obtained from the coal minable from the same area under existing mining methods. During one 8-hr period, combustible gas with a heating value of 90 Btu per cu ft was produced at a rate of 9.4 million cu ft a day. In other phases of the experiment when new inlets and outlets were driven near the burning coal faces, gases having calorific values of 75 to 150 Btu per cu ft were produced.

Entries in the 1947 project were driven from the outcrop into overburden averaging 30 ft, while those in the 1949–1950 experiment averaged 150 ft below the surface. In the pioneer experiment, the entries extended only 150 ft, compared with 1540 in the second project.

Inasmuch as methods of and processes for underground gasification still are in the experimental stage, no definite economic evaluation is offered in the report. It adds, however, that provided technical aspects are feasible, underground gasification of coal can be applied for the following uses:

1 Complete combustion of coal underground with air and utilization of the heat energy in gas turbines or in raising steam.

2 Production of producer gas with air and utilization of the combustible gas in gas turbines.

3 Production of synthesis gas by gasification of coal with oxygen and steam, and using the gas in the manufacture of synthetic liquid fuels or organic chemicals.

Further experiments are to be staged at Gorgas, the report revealed. A new installation is being constructed which features a series of electrodes for passing electric current through the coal seam to open passages for air and gases. The proposed bed to be tested covers a larger area with resultant greater distances between outcrops and it is expected that the new system will reduce leakage which hampered both previous experiments. The new electric system reduces site-development costs and virtually eliminates all underground labor.

A free copy of Report of Investigations 4808, "The Second Underground Gasification Experiment at Gorgas, Alabama," can be obtained from the Bureau of Mines, Publications Distribution Section, 4800 Forbes Street, Pittsburgh 13, Pa.

Lightweight Gyrocompass

A LIGHTWEIGHT gyrocompass which will withstand rough treatment without functioning failure or inaccuracy has been developed under a contract with the Army Corps of Engineers, the Department of the Army announced recently.

The new gyrocompass meets a need of modern warfare which requires precise navigation for vehicles in any area and under all conditions.

Use of the gyrocompass in World War II was limited because of the size and weight of the model. The old compass weighed 550 lb compared to 67 lb for the new model. It performs the same function of indicating true north. The earth's rotation and gravity produce the heading, and the unit is self-contained and self-sufficient. It is not affected by metallic objects.

The gyrocompass is dependable, simple to operate, and does not require any compensation or calibration calculations by the operator. The sensitive element is suspended in a high-density fluid. The suspension offers excellent protection. During field tests the compass stood up under severe treatment.

Designed to operate in temperatures ranging from —65 F to 130 F, the compass is protected from water and dust.

The gyrocompass was built by the Arma Corporation of Brooklyn, N. Y., under supervision of the Army Engineer Research and Development Laboratories at Fort Belvoir, Va. Service test models of the compass are presently being procured for evaluation by field forces. Standardization of the compass is expected within two years.

Heavy Press Program

A PROGRAM of design, construction, and operation of heavy forging and extrusion presses has been started by the U. S. Air Force.

These presses, larger than any heretofore built and operated in this country, are designed to speed the manufacture of aircraft, save materials in short supply, and reduce costs of fabrication.

Present plans call for the installation of 20 heavy forging and extrusion presses in a number of special plants located to serve the aircraft manufacturing industry and take advantage of existing supporting plants and equipment. Estimated cost of the program is $210,000,000 over the next four years.

The use of heavy forging and extrusion facilities to make large light-metal component parts for aircraft has proved more efficient than present methods of assembling the large component from numerous small pieces.

Heavy-press manufacturing techniques have been proved by production on presses up to 18,000 tons, now in use in several plants. Present capacity is inadequate in view of the aircraft-production program.

The program includes additional forging presses of the capacity proved in operation, as well as ones of heavier capacity. Discussions have included the technical advantages and limitations of a forging press of 75,000-ton capacity.

Underwater Television

UNDERWATER television may be used by the Navy to protect as well as aid human divers in their work, it was disclosed recently by the Navy Bureau of Ships.

Television cameras can explore undersea areas to help divers spot and prepare for dangerous situations, it was pointed out. In addition, the cameras may be used to observe the work of divers, making possible shipboard co-ordination of underwater activities.

Perhaps the first use of underwater television was during the evaluation of the Bikini atom-bomb tests in 1947. The camera was lowered from a control ship to depths as great as 180 ft, and was manipulated and focused by remote control from above. In some cases it photographed objects 30 ft away, transmitting images clearly and accurately. During one experiment, two cameras were used simultaneously.

The new underwater television cameras developed under the direction of the Bureau of Ships enable viewers to see under conditions where diver operation is not possible. A broad view of the whole area in which work is being done is provided by a wide-angle lens on the camera. When desired, a close-up of specific details can be provided simply by closing a switch on shipboard. This changes the camera lens from wide angle to telephoto.

It is hoped that one of the chief advantages of this system will be the time saved in underwater exploration. The time a diver can spend under water is severely limited due to the water pressure and to the time it takes to lower and raise him. At depths of more than 200 ft, the time spent in lowering and raising the diver exceeds the time a diver can spend on the bottom.

Television cameras, however, may be quickly lowered to the area. Used sometimes with suspended lights, they may enable personnel on the ship to examine accurately the ocean bottom for long periods of time. The pictures appearing on the television screen can also be filmed if further reference to them is necessary.

Also, individuals walking on the ocean floor may raise clouds of silt, which obstruct their vision. This is avoided by the use of the television cameras, which need not touch bottom, and thus may provide better visibility both as to distance and clarity than human divers have.

Underwater television was used during 1951 to locate the sunken British submarine *Affray*. Because of the difficulties of diver operations, the British Admiralty borrowed a standard television broadcasting camera from the British Broadcasting Corporation, put it in hastily devised watertight containers, and surveyed the area where the sunken sub was believed to be. The *Affray* was identified through the use of the television camera.

Another problem which the use of underwater television may help to meet is that of observing changing bottom conditions in areas where this happens rapidly. In this way chart corrections are facilitated.

Underwater conditions frequently depend upon surface conditions, especially in navigable shallow waters. If a storm rises the ocean bottom may change shape. In deep water, if divers are below during rough water, their lives are endangered. If not, their work is at least made more difficult and time is lost in resurveying.

Observers on the surface may plan a salvage operation prior to sending divers down by using underwater television. Diving time then would be reduced to that necessary for the divers' actual work.

Optimalizing Control Systems

PART of the results of a research program conducted in the Aeronautical Instrument Laboratory of the Massachusetts Institute of Technology, dealing with control systems for engines, was presented, by title, in a 160-page report at an Industrial Instruments and Regulators Division technical session during the 1951 ASME Annual Meeting in Atlantic City, N. J., by C. S. Draper, Mem. ASME, and Y. T. Li of M.I.T.

Entitled, "Principles of Optimalizing Control Systems and an Application to the Internal-Combustion Engine," the report outlines the background theory of optimalizing control in which an automatic unit is placed in the feedback branch of a system to function in the manner of a human operator in searching out and holding the best performance from a controlled system, in spite of any reasonable change of the output level or environmental operating conditions.

In order for an optimalizing action to be possible, the report states, the system to be controlled must have a performance characteristic which shows an optimum point as one or more controlled inputs are varied. In optimalizing control operation, a suitable deviation signal that represents the departure of operation from the optimum condition is generated and utilized as a basis for making corrections to the controlled input adjustments so that the deviation signal diminishes and the operating point approaches the optimum point.

Optimalizing systems of all kinds generate the deviation signal by the correlation of test input variations with the cor-

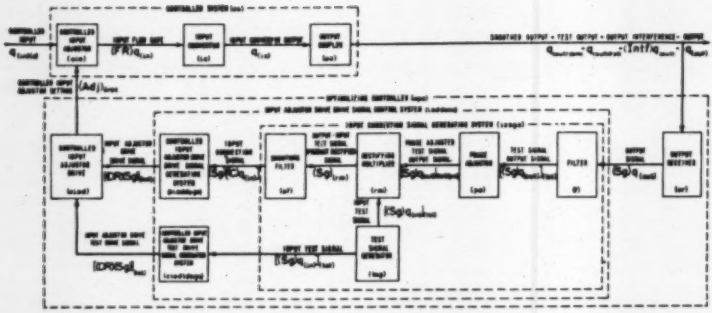

FIG. 9 FUNCTIONAL DIAGRAM FOR AN OPTIMALIZING CONTROLLER OF THE CONTINUOUS-TEST SIGNAL TYPE

responding output variations. The range of the controlled input test variation is called the input hunting zone, and that of the corresponding output variation is called the output hunting zone. Output variations due to causes other than the controlled input variations act as interference effects. The possibility of optimalizing controller action depends upon the existence of a frequency band with a sufficiently low range of interference levels to permit satisfactory operation of the output hunting action.

By definition, the rate of change of the output with respect to a given input is the controlled system sensitivity. At the optimum point of operation the controlled system sensitivity is zero. One class of optimalizing controller uses a signal based on this sensitivity as its essential input. A second class of optimalizing controller uses the deviations from an indicated optimum level signal produced within the equipment to operate the controller. Systems based upon this latter principle belong to the class of peak-holding controllers.

Systems based on direct observations of the time rate of output change to establish a sensitivity signal are badly affected by high-frequency interference components, which are unduly accentuated by the derivative-taking process. For this reason two special types of input-output sensitivity-operated controllers are considered in this report. Controllers of the continuous-test signal type operate by applying a relatively small-amplitude test input change, independent of the input adjustment, to the controlled system and then using the corresponding output variation to give a measure of the sensitivity. In this type of controller the essential output variation is localized in a narrow frequency band, and for this reason may be isolated from the existing interference by properly designed filters.

Controllers of the output sampling type obtain signals representing controlled system sensitivity by comparing the average output changes that occur during successive equal time intervals due to a given controlled input change. In this type of controller the effect of high-frequency interference is eliminated by the averaging process that occurs during a properly chosen sampling period.

Optimalizing controllers of the peak-holding class are less affected by high-frequency interference because no derivative of the output is required. For this reason controllers of this class are most suitable for optimalizing control of operating systems with strong high-frequency interference.

The ability of a controller to correct any performance deviation from the optimum condition of an operating system is one important characteristic of the controller. This characteristic is measured by the recovery time of the optimalizing system. The recovery time is defined as the time required to correct 95 per cent of any initial output deviation. The report includes a discussion of the recovery times to be expected from the use of various schemes for adjusting the controlled input.

The cyclic input and output hunting actions that necessarily accompany the use of optimalizing control are associated with a hunting loss that is a function of the output hunting zone. An analysis is given of the effect of high-frequency interference components on the realizable output hunting zone of a peak-holding type optimalizing system.

It is reported that nonlinearity in performance is an essential characteristic of any system capable of operating under optimalizing control. On the other hand, controller components and certain subsystems of controlled systems may be considered as effectively linear systems. An analysis is carried out to show the effects of combinations of first-order linear components on the response delay of the complete systems. The magnitude of the resultant response delay determines the lower limit on

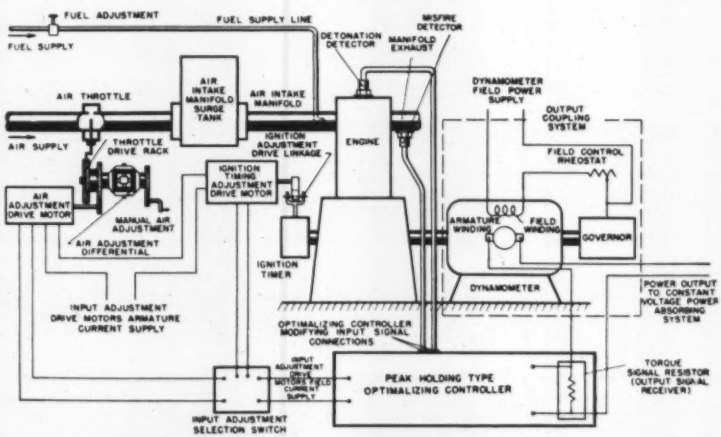

FIG. 10 COMPONENT LAYOUT DIAGRAM FOR A PEAK-HOLDING OPTIMALIZING CONTROLLER DESIGNED TO OPERATE THE AIR THROTTLE AND IGNITION-TIMING ADJUSTMENTS

the output hunting period. Response delay in linear components also causes the magnitude of the input hunting zone to increase.

The effects that determine the magnitude of the output hunting loss and methods for holding this loss to minimum levels are discussed.

A single-cylinder internal-combustion engine was selected as the system to be used for an experimental check on the validity of optimalizing control theory. This engine was chosen because of the strong interference components present in its output, which presented an extraordinarily difficult problem in controller design.

The goal of the optimalizing controlled engine performance was set to include a hunting loss of less than one tenth of one per cent of the full power output of the engine, together with a recovery time of less than 30 sec. A design procedure of the controller aimed to carry out these specifications is described. The test results obtained from a systematic experimental study of the control system shows that the specifications laid for the design were satisfactorily fulfilled.

Copies of this extensive report on "Optimalizing Control Systems," are available from ASME at $2 per copy to nonmembers and $1.60 per copy to ASME members. Orders should be sent to the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

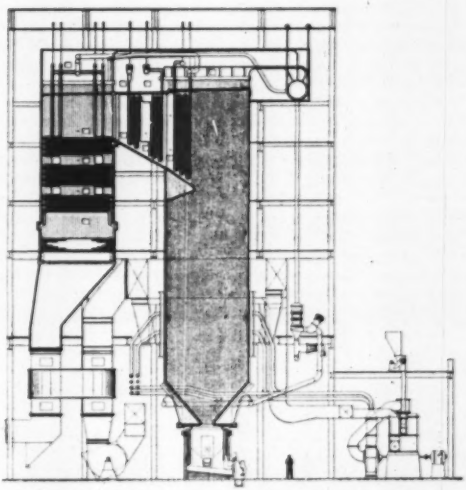

FIG. 11 CROSS SECTION OF TYPICAL CONTROLLED-CIRCULATION STEAM GENERATOR

Controlled-Circulation Boilers

EIGHTEEN large high-pressure steam-generating units of the controlled-circulation type for nine central stations in this country are being built or are on order from Combustion Engineering-Superheater, Inc., New York, N. Y. The units range in rated output from 750,000 to 1,450,000 lb of steam per hr (100,000 to 200,000 kw) and in design pressures from 1670 to 2650 psig. All employ reheat of 1000 or 1050 F and initial steam temperatures run from 1000 to 1100 F. Each unit will serve a single turbine-generator.

The most important feature of the controlled-circulation type, which distinguishes it from other forced-circulation types, is the use of orifices to regulate the admission of water to the various heating circuits. These, aided by the flow resistance provided by the small-diameter tubes, afford close control of water distribution.

More than ten years' experience and exhaustive tests with the pioneer 2000-psi, 650,000-lb per hr C-E unit, installed under direction of Stone & Webster as consulting engineers, at Somerset Station of the Montaup Electric Company; eight years' with a high make-up unit installed in 1943 at the Koppers synthetic-rubber plant in Kobuta, Pa.; and seven years' with large Naval units have been productive of much additional design and operating information which has resulted in refinements in design and established the advantages of controlled circulation for high-pressure service.

With natural circulation it is the difference between the weight of water in the downtakes and that of the mixture of steam and water in the risers that produces circulation. However, since there is a great increase in steam density and a marked decrease in water density at high pressures, this difference becomes less as the pressure increases. On the other hand, with controlled circulation not only is the head positively augmented by the pump but there is wide latitude in the arrangement and location of the heat-absorbing surfaces and drum.

Employment of a circulating pump permits the use of small-diameter ($1^1/_4$, $1^1/_2$, and $1^5/_8$-in.) thin-wall tubes. For the same hot face temperature these thin walls have nearly double the permissible heat absorption of the conventional natural-circulation tubes, which have approximately twice the wall thickness. However, since other considerations dictate that furnaces of both types of units be about the same size, with little difference in heat absorption per square foot of radiant surface, the small-diameter thin-wall tubes offer greater safety against undesirable thermal stress. This is most important at high pressures.

The pump, by providing forced circulation in starting, permits rapid pickup of heat by the water in all parts of the boiler, which equalizes stresses and thereby allows the unit to be brought up to operating conditions in minimum time. Furthermore, less time is required when shutting down, and since there is less water in the unit, time is saved in draining. This is in contrast to the conventional boiler which has no circulation in starting and in which subsequent circulation varies with output and pressure.

The weight of pressure parts (exclusive of the superheater) is about half that for a natural-circulation boiler of like capacity, which should be a factor under the present materials situation. All pressure joints are welded and the absence of rolled joints avoids the danger of acid or caustic attack at these locations. Handhole caps and gaskets are eliminated.

In general, the large units are provided with three circulating pumps, one of which is a spare. These are of the vertical-shaft type, suspended between the suction gate valves and the discharge nozzles. Pump foundations are thus eliminated and free expansion is permitted. The pumps operate only on the differential pressure necessary to overcome the resistance of the tubes.

In the matter of safety, a tube rupture is reported to be much less serious than in a natural-circulation boiler and immediate shutdown is unlikely.

Mobile Gas-Turbine Plant

CIVIL engineers of the U. S. Navy have designed a powerful, compact, mobile gas-turbine power plant capable of serving a city of 10,000 population.

A prototype plant will be constructed under a lump-sum competitive-bid contract, the Navy Bureau of Yards and Docks has announced. Plans and specifications are being drawn by Burns and Roe, a New York architectural and engineering firm, and should be ready by April 1, 1952.

The generator unit will be valuable in any power emergency, Navy civil engineers said. It is designed for all degrees of weather.

The prototype plant will contain one 4000-kw gas-turbine-generator set capable of producing electricity at a moment's notice. It will be a complete unit, with no outside services needed. One attendant and a supply of fuel oil will suffice to put it into operation.

The plant will have voltages of from 11,500 to 13,800 and can be connected to existing electrical systems merely by use of a standard 15,000-volt cable.

It is designed to fit a 70-ft railroad car, but will be removable for barge or ship transportation. Generators will have their own housing and will not require foundations for operation, either when mounted on the railroad car base or on the ground.

Because of its mobility on land or sea, the new power plant is likely to see overseas service, the Navy civil engineers said.

Cutting-Tool Jet Lubrication

IN the cutting of metals, if cutting fluids are to be of any value in lubricating the cutting edge as well as cooling it, the fluid must reach the edge of the tool. In the ordinary application, the cooling liquid falls on the chip and the exposed shank of the tool. It cools the edge only indirectly by conduction through the chip and along the shank of the tool.

A new method, called the Hi-Jet System, as proposed by R. J. S. Pigott, director, Engineering Division, Gulf Research and Development Company, Pittsburgh, Pa., consists of directing small high-speed jets of lubricant under the cutting edge of the tool. Mr. Pigott, a Fellow of ASME, is the current President of ASME.

The new method was demonstrated recently at the Gulf Research Laboratories in Pittsburgh and test results indicate that the new development will increase metal-cutting tool life from 300 to 1200 per cent and may also greatly increase metal-cutting capacity in general.

In the new system, streams of oil pass through the space between the work and the side relief face of the tool and are aimed at the line of contact between the work and the cutting edge. Part of the oil is forced past the cutting edge and is caught between the chip and the tool. Now, for the first time,

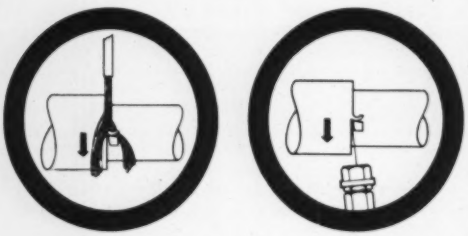

FIG. 12 DIAGRAMMATIC DRAWING SHOWS THE OLD OVERHEAD FLOOD METHOD AND NEW JET METHOD

(*Left:* Note that chip completely obscures cutting edge of the tool. *Right:* Hi-Jet method forces lubricant past the cutting edge under high pressure.)

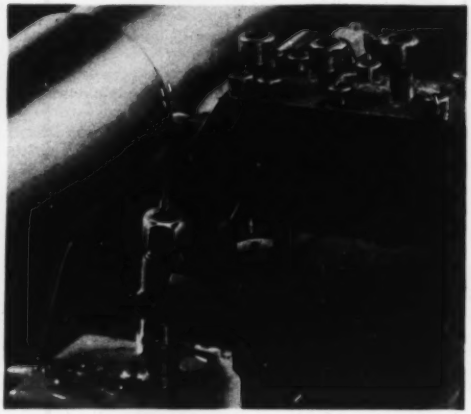

FIG. 13 SMALL HIGH-SPEED JET OF GULF HI-JET OIL DIRECTED FROM BELOW THE TOOL PASSES THROUGH THE SPACE BETWEEN THE WORK AND THE SIDE RELIEF FACE OF THE TOOL

the tool is being efficiently lubricated, and heat transfer away from the cutting edge is greatly improved.

The entire unit consists of a jet, or a series of jets, flexible tubing, and a small pump capable of providing 400 psi of pressure.

Hi-Jet will be manufactured by Thompson Products, Inc., of Cleveland, Ohio, under licenses from Gulf Research & Development Company. Current tooling schedules indicate delivery of the first production units on or about July 1, 1952.

The new system was in the experimental stage for nearly a year, and over 600 tests have been made on a variety of metals ranging from SAE 1020 to titanium. All the tests showed a remarkable improvement in cutting-tool life with the increase on high-speed tools from 6 to 12 times and on carbide tools from 3 to 5 times.

For use in the new Hi-Jet System, a special oil, known as Gulf Hi-Jet Oil, has been developed. This came as a result of tests on more than 50 types of oil, which entailed the development of 35 new oils plus the testing of over 15 existing oils.

Since the Hi-Jet oil gets to the exact point of contact between the cutting tool and work surface, there is considerably more heat carried away, and as a result a great deal more smoke is generated. For this reason a number of attachments have been developed which will serve as smoke quenchers.

One of these attachments is a series of shower heads placed above and below the cutting surface. It will utilize the available overhead flood equipment, but by using the liquid to form a thin curtain rather than a single river, it provides a much more effective job. The addition of this equipment, however, in no way influences the operation of Hi-Jet, since it is merely a smoke quencher and is in no way a lubricant or a coolant.

One of the outstanding advantages of this new system, Mr. Pigott pointed out, is the fact that the operator has the choice of operating his machine at conventional speeds with a greatly increased tool life, or doubling, and sometimes even tripling, his speed of operation with no resultant reduction in tool life.

Examining the results of tests on the new high-speed jet method, Mr. Pigott said that it appears that several conditions have been obtained that were entirely absent in the old low-speed streams.

1 The use of a jet small enough to enter the gap between the heel of tool and work has greatly improved penetration at any jet speed. There is no disturbance by crossflow from splash on the tool.

2 With any fluid the cooling is greatly improved, since contact with the tool is direct, the flow velocities far higher, and the liquid is in a thin sheet. This condition has been easily proved by the reduction of edge temperature. Two to three times the cooling has been obtained with one-twentieth the oil circulation.

3 A considerable increase in vapor and smoke (when not using an auxiliary quenching stream) shows that liquid is boiling near the cutting edge.

4 Cutting liquid is passing the edge of the tool, probably as vapor, and is recondensed on top of the tool by the cooler work and chip. It passes up through the channels occasioned by difference in roughness between the cut face and tool. The work shears ahead of the tool edge, its roughness being 50 to 60 microinches; the tool-edge roughness is 6 to 10 microinches.

In working out the theory of the mechanism that accounts for the flow of oil past a tool edge, it was found that the speed of the jet will produce an impact pressure opposite the jet under the tool edge, less the friction loss up the wedge passage. After the right-angle turn, the pressure, in general, will be equal to the friction loss to produce the flow along the passage parallel to the tool edge. One form of slit jet provides adequately for a long cut, and can provide a pressure of any desired value by change of jet position and number, or by using slit-shaped jets. It is this static pressure under the tool edge that provides the driving force to put the cutting fluid over the edge of the tool. But obviously, jet pressures of 350 to 500 psi would not suffice to force any liquid or vapor past the edge pressures of the order of 50,000 psi. Capillarity is almost nothing—of the order of a few hundredths psi. It is therefore the tiny passages caused by difference in roughness that furnish the necessary channels for flow. Calculations show that the pressure in the passage due to jet speed of 225 to 260 fps could not flow oil of viscosities 100 to 200 SUS up these passages as liquid oil. But it is known that the tool edge is from 950 to 1100 F, and the oil is therefore boiling. Vapor can be passed over the edge by the pressures available and since the work and chip are cooler than the boiling temperature of the oil, the vapor condenses again into liquid oil as soon as it passes the edge.

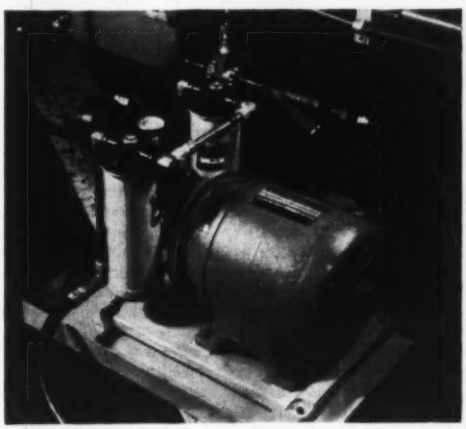

FIG. 14 PUMP, MOTOR, AND FLEXIBLE TUBING THROUGH WHICH OIL FLOWS TO THE NOZZLE, ARE IMPORTANT ELEMENTS OF THE ASSEMBLY

Proof that oil passes the edge is evidenced by the following: (1) Elimination of build-up; (2) chip crater uniform in each test; (3) little nose wear; (4) failure by washout farthest from the (single) jet on the cutting edge—the position of the washout will vary with jet arrangement; (5) finish greatly improved—the finish is determined by the nose, not the cutting edge.

Tests, run all the way from 25 to 600 psi, indicated that there is no great improvement up to 50 psi, but that there is a distinct critical jet speed at about 400 psi that gives best results.

In actual tests performed during the demonstration, the following results were obtained:

Test conditions—Feed, 0.011 in.; depth of cut, 0.088 in.; material, SAE 1045, 185 Bhn; tool steel 18-4-1 H. S.

		Tool life, sec	
Test	Sfm	Lathe 1	Lathe 2
Overhead flood	250	23	25
Hi-Jet	250	366	983
Overhead flood	200	71	77
Hi-Jet	200	8275	9724

In addition to the immediate advantages, the new development offers other indirect advantages.

As a result of increased tool life, setup and tool grinding time on many jobs can be greatly reduced. Also, because the tools last longer, fewer tools are needed. On large-production jobs this means substantial savings in tool inventory and tool cost.

It seems certain that with the tremendous improvements now made possible in high-speed tool life and cutting speeds, the use of high-speed tool steels will be greatly increased. This is especially desirable at the present time because of the scarcity of sintered tungsten carbides and the increasing demands brought about by the nation's defense program.

An important advantage of the improved surface finish and dimensional accuracy on work machined with Hi-Jet is the reduced need for additional finishing operations. In some cases the finishing operation can be entirely eliminated. Grinding time, too, can often be reduced because of the smaller dimensional variations.

Another advantage: There is less tendency toward work-hardening of the machined parts. On some jobs this may mean that stresses which cause distortion and surface hardening are reduced.

Rolling-Mill Lubricant

RESEARCH by the Ironsides Company of Columbus, Ohio, has perfected a superior lubricant for use in tin-plate rolling operations, produced entirely from freely available domestic materials. Reports indicate that the new lubricant duplicates all the chemical characteristics of palm oil. It looks, feels, acts, handles like palm oil and requires no changes in rolling-mill operation. It is said to be superior to palm oil in that it is subject to exact chemical control.

Trade-named Palmoshield, the new lubricant has been under continuous testing for the past three years in cold rolling steel production under standard operating conditions. Rolling characteristics were reported equal to palm oil. The cleaning operation was above average. Annealing and temper rolling were up to standard in every way. Tinning, both hot-dip and electrolytic, yielded a most satisfactory product. During

this testing Palmoshield was reclaimed with good results both as to yield and product.

All tests have substantiated the fact that domestic Palmoshield has four distinct advantages over imported palm oil:

1 Palmoshield is widely available in this country. Users are not dependent on shipping during unsettled world conditions.

2 The domestic materials which go into Palmoshield are so freely available as to supply all steel production of the United States without "borrowing" from other defense requirements.

3 Due to its availability, Palmoshield need not be stockpiled. However, there is no deterioration from extended storage.

4 Palmoshield is subject to exact chemical control. The free fatty acid content does not vary from batch to batch and can be specified by the user.

A number of steel-mill laboratories have checked all the chemical characteristics of Palmoshield as being well within the data limits for palm oil. One mill operator, in fact, has still to be convinced that palm oil is not an ingredient of Palmoshield.

Arcair Process

THE Arcair process of removing metal through the utilization of an Arcair torch was described by Hubert Chappie, foundry superintendent of The National Supply Company, Torrance, Calif., before a meeting of the Steel Founder's Society of America in Cleveland, Ohio, recently. The torch requires a $^3/_8 \times 12$-in. carbon electrode, an ordinary 300 to 400-amp d-c welding machine, and a quantity of compressed air.

A compact gouging and cutting torch, it is only $10^1/_8$ in. in over-all length. The torch contains an air-control valve and rotating nozzle, which permits changing the electrode angle to suit the job, while maintaining the jet in perfect alignment. No gas cylinders or regulators are necessary.

In the rotating nozzle which holds the electrode there are two small holes, approximately $^1/_8$ in. in diam, which serve as the outlet for the air. This enables the air to run parallel to the carbon electrode.

There is one hose connection to the torch, which contains the electrical lead and the compressed air. These two leads are combined into one hose for ease of handling.

Air pressure used with the torch ranges from 80 to 90 lb. However, the pressure could be as low as 60 lb and still be effective.

According to Mr. Chappie, the torch is most efficient and

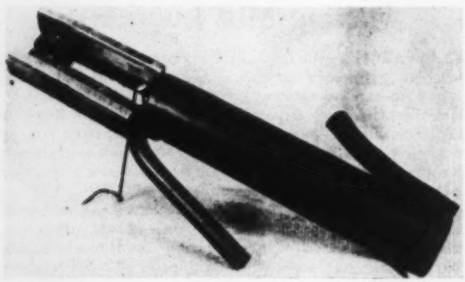

FIG. 15 ARCAIR GOUGING AND CUTTING TORCH IS ONLY $10^1/_4$ IN. IN OVER-ALL LENGTH

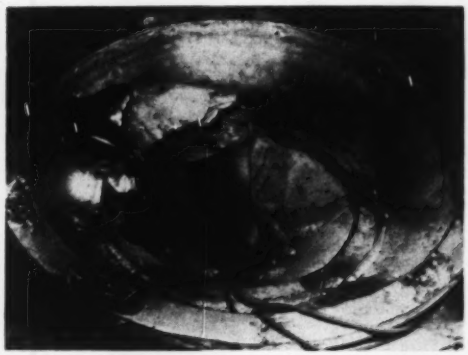

FIG. 16 PADDING HEADS ARE REMOVED WITH ARCAIR TORCH

economical when removing cracks in the foundry cleaning room. Ribs, fins, and riser pads can also be removed with ease. The continuous air flow results in a clean and smooth cut. The torch readily removes sand or dirt spots, is said to have more maneuverability than other torches, and is particularly adaptable in confined corners or places where the use of a chipping hammer is impossible. Shrinks under a riser are prepared for welding by the torch with less metal removed than results when chipping is employed. It is common knowledge that during defect removal by chipping, the deeper the hole, the greater the hole diameter becomes on the surface of the casting, resulting in the waste of much sound metal and requiring greater amounts of weld metal.

The first torch combining the arc and the air blast was made in 1948, and with it a total of 2400 ft of $^3/_8$-in. austenitic fillet weld were removed in 20 man-days. Removal by chipping would have taken at least 120 man-days and redressing chisels about 12,000 times, Mr. Chappie said. It was first put on the market about a year ago and used on the University of Washington Stadium, by Consolidated Western Steel. Since that time it has found wide use in structural fabrication, foundries, steel mills, and other manufacturing plants where metal removal was required. Although designed originally for stainless steel, today 90 per cent of the torches in the field are used on mild steel competing with oxygen and acetylene, or mechanical methods, Mr. Chappie stated.

Since the Arcair torch employs a continuous flow of air during the cutting operation, the question has been raised as to what temperature the steel would be after cutting compared to that when an oxygen torch was used. A 6-in. round steel plate $^3/_4$ in. thick was secured, and cut with an Arcair torch for one minute. A pyrometer recorded a temperature of 250 F. The same test was made with an oxygen gouging torch and a temperature of 600 F recorded; or 350 F more temperature resulted when using the oxygen torch for one minute.

The same kind of test, but with a two-minute cutting interval, resulted in a temperature rise of 450 F when using the Arcair torch and a temperature recording of 850 to 1000 F for the oxygen gouging torch. Again there was 400 F more temperature when using a torch operated with oxygen.

According to the manufacturer, Arcair Company, Bremerton, Wash., the torch can cut a groove $^3/_8$ in. wide and over 2 ft long in one minute. This has been substantiated by tests at The National Supply Company which show a groove can be cut 3 ft long, $^3/_8$ in. wide, and $^1/_4$ in. deep in one minute.

Numerous other tests were made comparing Arcair and the

gouging oxygen torch and the tests indicated practically no difference in speed between the two processes. Some tests indicated that Arcair cuts more metal per minute and others favored the gouging torch. A review of all tests definitely shows that the two torches are of equal cutting speed.

Tests conducted comparing Arcair versus chipping lead to the conclusion that in a given time the Arcair process could remove 200 per cent more metal than could be removed by chipping. In other words, Mr. Chappie said, one Arcair cutter can replace three chippers.

All the tests were made on a 0.25 per cent carbon steel. When used on alloy steels, the method would allow further savings, he pointed out.

Another large economy in using the Arcair torch is the saving of oxygen and acetylene. Cost comparisons made between the Arcair and oxygen-acetylene torches indicate monthly savings of nearly $1000 when using the Arcair process.

Unique House

A UNIQUE experimental house has been built on the University of Illinois campus at Urbana-Champaign, Ill., by the Small Homes Council, as part of a research project sponsored by the Housing and Home Finance Agency on residential space use.

The house is so flexible in its use of interior space that even the bathroom and kitchen can be moved to different locations inside the structure. Use of flexible connections instead of regular pipe and fittings makes this possible.

The entire house can be made larger or smaller in a few hours by two men with the simplest tools.

Results of the project are expected to help the housing industry build the greatest amount of needed space into homes with minimum waste.

It will be lived in by two representative families, one after the other, to test different space situations. Different sizes and shapes as well as different arrangements of rooms and fixtures will be tested by each family.

On the outside, the test structure looks like almost any small one-story house of contemporary design—but probably no other house is as "changeable." It is constructed so that the interior partitions and outside walls are free of the roof weight, and therefore are readily movable. This permits size, shape, and location of all rooms to be changed at will.

The bathtub is on wheels, while the other bathroom fixtures are on wall panels which can be moved. It will be possible to split the bathroom, thus providing the popular divided bath if space studies require it.

All the kitchen equipment likewise is readily movable.

The house is built on a 32 × 48-ft floor area. Now a 24 × 36-ft structure, it can be made larger or smaller by merely changing the positions of the outside walls and adding floor panels. Shifting the walls about is easy to do because the entire weight of the roof is supported by columns placed at the edges of the structure.

There is no roof or ceiling over that part of the laboratory not enclosed by the house. This will be added later when it is required.

The wall panels themselves are variable. Different panels will offer a variety of window sizes and door sizes as the tests require.

Two families will occupy the house, each for a period of six months, according to plans outlined by Prof. Rudard A. Jones, Small Homes Council architect and chairman of the University committee working on the space study.

Families will be representative of those occupying small houses today. According to specifications, each family will consist of a couple, approximately 30 years old, having two children—a girl and a boy, one of whom is to be of school age and the other of preschool age.

Each family living in the house is to be subjected to various changes in room arrangement. A new room arrangement will be tried each month. Both the size and location of rooms will be varied. Some space arrangements that differ radically from those used in the majority of homes today will be included.

At the end of each month the members of the family will be questioned concerning their reactions to the particular arrangement tried that month. Both the efficiency of the arrangement and the psychological effect will be charted. Wherever possible, quantitative measurements will be taken. The number of steps required in the use of household equipment and the pattern of movements in working about the house will be recorded mechanically. Pedometers, electric-eye counters, door counters, and similar instruments will be used to trace traffic patterns within the house.

As a final test, the occupants will be given an opportunity to suggest some arrangement plan which they would like to try.

By these methods, the researchers hope to be able to compare room arrangements. This laboratory approach to the study of space has been impossible to achieve in the field-survey types of study previously made.

Photoelastic Stress Analysis

A NEW method of three-dimensional photoelastic stress analysis has been developed by Dr. Max M. Frocht, Mem. ASME, research professor and director of experimental stress analysis at Illinois Institute of Technology, Chicago, Ill., and Roscoe Guernsey, associate professor at the University of Texas, formerly a research fellow at Illinois Tech.

It is reported that with the new method it is now possible to determine the actual principal stresses at any interior point of a body. Prior to this development, only principal shears could be found.

In making such a study, Dr. Frocht first machines a plastic model of the part to be analyzed. This is then placed in a special furnace designed for this purpose.

The loads are applied while the plastic model is heated to a suitable high temperature and are not removed until after the model cools to room temperature. The stresses developed by the loads are in this way "fixed" or "frozen" into the model.

The model can then be sliced or sectioned without disturbing the frozen stresses. These sections, when placed in a photoelastic polariscope, reveal a stress pattern which can be observed and photographed.

The stresses present at any point in a section can be studied in detail and the complete stress system, consisting of maximum, minimum, and intermediate stresses, can be found.

Four points stand out in the development: (1) The method is new. (2) Methods previously proposed required special materials not available in this country. The present method is effective with available materials such as Fosterite. (3) Previous methods were limited to the elastic state. The new method applies to both plastic and elastic stresses in the model. (4) The method has been applied to a specific problem with a great deal of accuracy.

The method makes it possible to study three-dimensional stresses in complicated machine parts and structural elements which had hitherto defied both theoretical and experimental analysis and should materially contribute to more rational and efficient design.

ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

Steam Power Generation

Comparative Efficiencies of Central Station Reheat and Nonreheat Steam Turbine-Generator Units, by C. W. Elston, Mem. ASME, and P. H. Knowlton, Mem. ASME, General Electric Company, Schenectady, N. Y. 1951 ASME Annual Meeting paper No. **51—A-139** (mimeographed).

THIS paper provides information concerning the performance of large steam turbine-generator units of modern design, for modern steam conditions and ratings, and shows something of the background of experience from which the information is derived. A similar exposition was made in 1940, along somewhat different lines, and with no particular information on the reheat machines, which have become much more popular in the past few years. The present paper shows the amount of test information obtained on complete turbine-generator units since 1940, and also, by comparing test results with guaranteed figures, shows the efficacy of the general performance calculation method given. This method is based on the 1940 data as well as on the test data accumulated in the last decade. During this period, certain definite trends in the large-turbine field have been apparent; moreover, since during the war years little new development in central-station turbines was undertaken, the present discussion mostly concerns events of the past 6 years at G-E.

In view of these trends, an analysis has been made of the applicable data, and the following information is presented:

1 Charts showing the range of sizes and steam conditions of units tested since 1940. In this connection it is interesting to note that in the compilation of data presented in 1940, only two tests on condensing turbines at 1200 psi were available, since most of the application of such pressures had been made in topping turbines. Also, no machines had been tested at a temperature over 950 F.

2 A complete description of a general method of predicting over-all performance of turbines designed for reheat, as well as for the nonreheat cycle.

3 New information regarding the efficiences of the larger hydrogen-cooled generators, at both 1800 rpm and 3600 rpm, with data on mechanical losses to correspond.

4 New exhaust loss curves for the larger 3600-rpm exhaust stages now in use or being manufactured.

Operation and Performance of Modern Reheat Boilers, by P. R. Loughin, Mem. ASME, and H. H. Poor, Mem. ASME, The Babcock & Wilcox Company, New York, N. Y. 1951 ASME Annual Meeting paper No. **51—A-80** (mimeographed; to be published in Trans. ASME).

DURING World War II the price of fuel increased markedly in the United States, outdistancing the less rapidly rising first cost of capital equipment. During the 1930's the straight-condensing regenerative cycle was found to be more economical than the reheat-regenerative cycle, but the wartime change in price structure made the more efficient reheat cycle economically attractive for many postwar power plants.

Reheat has been applied to a number of different designs. One type of dry-ash-removal unit is the first boiler at the new Tanners Creek Plant of Indiana and Michigan Electric Company. It is designed to deliver 930,000 lb per hr of high-pressure steam at 2080 psi and 1050 F, and 840,000 lb per hr of reheat steam at 390 psi and 1000 F. Constant high-pressure and reheat steam temperatures are obtained over a considerable range in load by raising the steam temperature at low load by means of flue-gas recirculation or lowering the steam temperature at high load by spray attemperation.

Another design of dry-ash-removal unit is the boiler for the Salem Harbor Station of New England Power Company. It will deliver 625,000 lb per hr of high-pressure steam at 1500 psi and 1000 F, and 545,000 lb per hr of reheat steam at 410 psi and 1000 F. Steam temperature may be regulated at low loads by selection of burner elevation and at high load by spray attemperation.

The largest boiler yet designed by B&W is a slag-tap unit for the new Muskingum River Plant of Ohio Power Company now under construction. It is 56 ft wide center line to center line of

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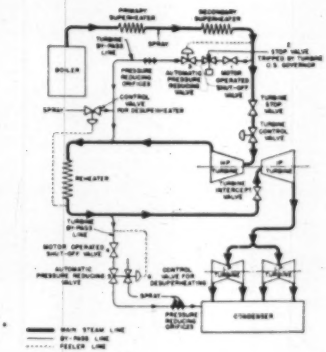


SCHEMATIC PIPING LAYOUT FOR QUICK-STARTING HOT REHEAT TURBINE

side-wall tubes, and will have a heat input of 1,880,000,000 Btu per hr, obtained from the combustion of 89 tons of coal per hr. Maximum continuous rating is 1,335,000 lb per hr of high-pressure steam at 2075 psi and 1050 F, and 1,226,000 lb per hr of reheat steam at 470 psi and 1050 F. Under these conditions the generators will deliver 217 gross megawatts. Steam temperature control is by flue-gas recirculation at low load and by spray attemperation at high load.

This paper illustrates these and other typical designs of reheat boilers and discusses operating procedures for normal start-up, quick start-up, normal operation, and shutdown under normal or emergency conditions.

Some Design Factors Relating to Performance and Operation of Reheat Boilers, by Henry H. Hemenway, Jun. ASME, Foster Wheeler Corporation, New York, N. Y. 1951 ASME Annual Meeting paper No. **51—A-142** (mimeographed; to be published in Trans. ASME).

REHEAT boilers designed to operate with low furnace exit-gas temperatures and at the same time to provide control of superheater and reheater outlet steam temperatures over wide load ranges are illustrated and described. Various means for controlling primary and reheat steam temperatures are discussed as are design provisions for some of the operating and maintenance problems peculiar to reheat units. Some advantages and disadvantages of indirect reheating are given.

The paper points out that with increased primary steam pressures and temperatures and reheat temperatures the furnace exit-gas temperatures must be increased with increase in slagging difficulties unless radiant superheater or reheater surface is used. With combination radiant and convection superheater surface the steam temperature control range may be increased to extend from 30 to 100 per cent.

Starting up, control, and protection of reheat boilers offer no particular problems. From the design standpoint there are no deterrents to the construction and operation of steam generators for more efficient reheat installations.

A Progress Report of Reheat Boiler Operation and Design, by W. J. Vogel, Mem. ASME, and E. M. Powell, Mem. ASME, Combustion Engineering-Superheater, Inc., New York, N. Y. 1951 ASME Annual Meeting paper No. **51—A-144** (mimeographed, out of stock; to be published in Trans. ASME).

A CONSIDERABLE number of reheat units have been placed in operation since 1948. This paper discusses the performance of several of these new units and describes some of the special features of operation.

Of the 87 CE-S reheat units of the post-war design, 13 either have been placed in commercial operation or were expected to be by the end of 1951. All of them were put in service without any abnormal difficulties indicating that the addition of reheat equipment has not complicated the design or operation or reduced the reliability of the steam-generating unit.

All but one of these units have been designed from certain basic principles and therefore are very nearly standardized. Fundamentally, the reheat steam temperature is controlled by vertical adjustment of the burners which are arranged for tangential firing. Since the primary superheater does not have the same temperature characteristic as the reheater it is necessary to provide supplementary control which has usually taken the form of a spray-type desuperheater to limit the temperature of the high-pressure steam at reduced loads.

This control system was chosen instead of regulating the high-pressure steam with the burners to avoid the necessity of adding spray water to the reheat steam. Water added at that point would reduce the steam flow through the high-pressure turbine and sacrifice some over-all cycle efficiency.

The combined operating experience from the units already in operation covering numerous start-ups, trip-outs, and a variety of operating conditions has fully justified the faith so many engineers placed in the manufacturers' ability to design reheat units which would be at least as reliable as the standard straight-through unit, the paper reports. The substantial increase in cycle efficiency has been obtained with no sacrifice in the availability of the equipment. There is little doubt that an almost complete shift to reheat can be anticipated in utility stations located in high fuel-cost areas in the future.

Reheat Experiences at Port Washington, by M. K. Drewry, Mem. ASME, Wisconsin Electric Power Company, Milwaukee, Wis. 1951 ASME Annual Meeting paper No. **51—A-45** (in type; to be published in Trans. ASME).

THE following are treated: (*a*) Starting schedules after shutdowns of various durations, (*b*) reheat economics, based on experiences, (*c*) conversion to centralized control of auxiliaries, (*d*) reheat-steam temperature control, (*e*) turbine overspeed control as affected by reheat, and (*f*) reliability data. That reheat has been desirable in all respects is indicated.

The First Year's Operation of the Dunkirk Steam Station, by J. N. Ewart, Mem. ASME, Niagara Mohawk Power Corporation, Buffalo, N. Y. 1951 ASME Annual Meeting paper No. **51—A-138** (mimeographed; to be published in Trans. ASME).

THE Dunkirk Steam Station went on commercial service on November 19, 1950, when the first unit was placed in regular operation. The second unit went on commercial operation on December 28 of the same year. The first year's operation has not been without troubles which are likely to occur in breaking in a plant incorporating several new and untried developments. Nevertheless, its performance has been generally satisfactory. Operation of the reheat units has introduced no new limitation in flexibility nor increase in operating personnel over the nonreheat units and the improved economy has more than justified its adoption.

This station comprises two single-boiler single-turbine reheat units. The turbines are rated at 80,000 kw, 0.8 pf, 100,000 kva at 0.5 psi hydrogen with a capability of 100,000 kw, 0.8 pf, 120,000 kva at 25 psi hydrogen. Steam conditions are 1450 psi, 1000/1000 F at the turbine control valves. The turbine generators are tandem compound, reverse flow, double flow, 3600 rpm, manufactured by the General Electric Company. The reheat boilers are of the bent-tube, radiant-reheat, single-pass type with water-cooled furnaces, two-stage superheaters, interstage reheaters,

few tube economizers, and Ljungström air heaters furnished and installed by Combustion Engineering-Superheater, Inc.

Twenty-Five Years of Reheat Operating Experience on the A. G. & E. System, by S. N. Fiala, Mem. ASME, American Gas & Electric Service Corporation, New York, N. Y. 1951 ASME Annual Meeting paper No. **51—A-70** (mimeographed; to be published in Trans. ASME).

INTEREST in the reheat regenerative cycle, as manifested in boiler and turbine sales data, has been greatly intensified in the postwar years. This paper contributes to the general historical record of reheat development by citing some of the experiences of the American Gas and Electric Company during the past 25 years. Operating features of some of the older units on the system are described but the emphasis has been placed on the characteristics of the modern units. Starting and stopping procedures, emergency shutdowns, temperature control, and performance are some of the topics discussed.

For example, in 1947 the fundamentals learned in the past, particularly in connection with the 2300 psi Twin Branch unit, were used to design a single boiler turbine unit developing a gross generation of 150,000 kw. Primary-steam conditions were 2000 psi, 1050 F. Reheat was to 1000 F. Five such units are now in operation.

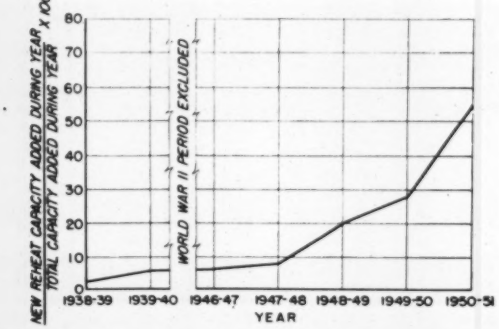
Now four still larger units are under construction. Two of these are for the Kanawha River Plant of the Appalachian Electric Power Company, located near Charleston, W. Va. The others are for the Muskingum River Plant of The Ohio Power Company, at Beverly, Ohio. Each unit of this group of four will be of the single boiler turbine type and will generate 217,000 kw at 2000 psi, 1050 F primary, and 1050 F reheat steam temperatures. At full load this will require a heat input to the boiler of 1.86×10^9 Btu per hr. The net heat rate is expected to be just over 9000 Btu per net kwhr. At the completion of the present construction program, the total net capability of all reheat units on the A.G.&E. System will amount to 2,250,000 kw.

Operating Experience With Reheat at Edgar Station, by H. E. Stickle, Mem. ASME, Boston Edison Company, Boston, Mass. 1951 ASME Annual Meeting paper No. **51—A-135** (mimeographed; to be published in Trans. ASME).

THE reheat cycle has been in use at Edgar Station since 1925. The first installation was a single boiler with high-pressure topping turbine which exhausted into existing 350-psi condensing turbines. The exhaust from the high-pressure turbine was at a temperature of only a few degrees above saturation and therefore had to be reheated before it could be used in the existing 350-psi turbines. This reheating was accomplished by means of reheater surface located in the second and third passes of the high-pressure boiler. The second addition was completed in 1929 and consisted of one more 350-psi 725-F condensing machine, two 1200-psi 700-F topping turbines, and four 1400-psi 750-F, 750-F reheat boilers. This so-called second addition was a departure from the unit system and was cross-connected at the 1200-psi level, the high-pressure turbine exhaust level, and at the 350-psi main steam header which supplied all of the 350-psi turbines. The steam flow through the individual reheaters was regulated by means of motor-operated regulating valves on the outlet of each reheater. The temperature regulation was accomplished manually by the boiler-room personnel as required to maintain optimum steam temperatures. The third addition to this station returned again to the unit system and was started up in August, 1949.

This paper describes operating experience with this new 81,250-kw, 1450-psi, 1000-F, 1000-F reheat unit.

According to the paper there have been no operating difficulties that can be attributed to the reheat cycle. With the increased reliability that is being built into power-plant equipment today, analyses of the economics of various cycles may be approached with confidence that the expected return on the additional investment will be obtained.



RELATIONSHIP BETWEEN REHEAT CAPACITY INSTALLED EACH YEAR AND TOTAL CAPACITY INSTALLED EACH YEAR BY PUBLIC UTILITIES 1938-1951

Experimental Superheater for Steam at 2000 Psi and 1250 F—Progress Report of Field Operation, by F. G. Ely, Mem. ASME, and F. Eberle, The Babcock & Wilcox Company, Alliance, Ohio. 1951 ASME Annual Meeting paper No. **51—A-37** (in type; to be published in Trans. ASME).

TO investigate the properties of new superstrength alloys for high-temperature steam-superheater service a test element constructed of 2-in-OD alloy tubes was installed in an operating boiler at Twin Branch Plant and supplied with steam at 2000 psig 950 F, which was heated to 1250 F. Operating conditions, and results of the first 5000 service hours are described in this paper. The test is being continued for thorough evaluation of the materials.

Wood Technology

Profitable By-Products From Wood Manufacturing Waste, by P. H. Graham, Manchester, N. H. 1951 ASME Annual Meeting paper No. **51—A-84** (mimeographed).

WOOD manufacturing waste is considered from the standpoint of secondary manufacturing plants which produce wood products by mass-production methods. More specifically, the paper includes wood material that cannot be used profitably in the manufacture of the major product from lumber. This manufacturing waste is usually divided into two classifications: unavoidable waste—cutting-up waste produced by selective cutting of lumber for various parts of the major product which is governed by the grade of lumber purchases and the quality of cuttings required, necessary spoilage allowance, shavings, and sawdust; and avoidable waste—waste re-

sulting from faulty workmanship and spoilage in machining.

In the average wood-products production plant as much as 15 per cent of the lumber cut becomes manufacturing waste, and this figure may be easily doubled where the wood products manufactured are of such quality and size as to have limited cutting dimensions. Waste material found to be profitable to salvage in one plant is not in others because of the differences in plants and in the equipment available. Also, what may be salvaged in one plant cannot be profitably utilized in others because of the differences in product and markets which they serve.

In the final analysis the most profitable by-product which may be produced from manufacturing waste is raw material that another production plant can use in the manufacture of its major product. The successive cycle of distribution of this raw material could be continued until the home-workshop craftsman has been reached.

Woodworking Machinery Manufacturers Look at Carbide-Tool Cutting, by Ray C. DuBrucq, president, Association of Manufacturers of Woodworking Machinery, and vice-president, Crescent Machine Division of Rockwell Manufacturing Company, Washington, D. C. 1951 ASME Annual Meeting paper No. **51—A-85** (mimeographed).

RESULTS of a study of conditions surrounding the applications of carbide cutting tools to woodworking machinery are presented. Submitted are quotations from several reports from woodworking-machinery manufacturers indicating their experiences and opinions of carbide tools. How to bring together all industries involved in the production and usage of these tools in an effort to promote maximum usage, is the object of this paper.

It is indicated that carbide-cutter acceptance is in its early stages, but far enough developed to call for full co-operation of all interested industries. This co-operation can result in success only through a definite knowledge of each others' problems and participation in the development of carbide usage.

To bring about a closer co-operation, the tool manufacturer should contact the machinery manufacturer more often.

With usage, history, and a definite knowledge of the requirements for proper usage, the woodworking-machinery manufacturer should be in the picture more strongly. He should look at his product and determine what is needed to best suit it for carbide-cutter usage. In most cases the modern machine is highly qualified. There are, however, fringe requirements that might aid the woodworker. A new approach to cutter maintenance could be the most important one. This problem seems to be the one thing every user talks about.

Elements of Circular Saw Design, by Norman C. Bye, Mem. ASME, Henry Disston & Sons, Inc., Philadelphia, Pa. 1951 ASME Annual Meeting paper No. **51—A-120** (mimeographed).

IN practice, saw blades can be made to operate stably at required speeds if compensation is made for rotational stresses. Maintenance of stability under operating conditions can be obtained if sufficient blade strength is provided to give a stability range sufficient to take care of operating stresses from work load, speed range, machine vibration, heating, shock, etc. Various methods of providing blade strength, such as increased thickness, heavy centers, large flanges, all help in obtaining better results. Practical experience and experimentation will still play a major part in establishing the limits which are used but the theoretical study at least gives some knowledge as to how to evaluate the various factors which are involved and to indicate where use can be made of modern methods and materials to obtain improvements in operation.

As operation is normally judged by kerf loss, finish, and speed of cutting, the successful use of thin, sturdy, stable saw blades becomes of great importance. If the factors which influence the behavior of rotating disks are considered, improvements in operating conditions along the following lines will contribute to better results:

1 Efficient cutting points properly maintained will reduce the work load on the rim of the saw and correspondingly reduce the amount of power which has to be transmitted by the blade.

2 Power drives with narrow speed regulations no load to full load will enable blades with narrower ranges of stability to be used.

3 Machines with precision bearings, dynamically balanced rotating parts, and built-in vibration dampers will reduce the excitation of vibration in the saw blades themselves.

Comparative Costs and Operation of Carbide-Tipped Saws, by Claude E. Drake, Drake Corporation, St. Louis, Mo. 1951 ASME Annual Meeting paper No. **51—A-121** (mimeographed).

THIS paper outlines the factors involved in efficient and economical operation and maintenance of carbide-tipped saws and certain fundamentals of new design, which are undeniably related to efficient saw operation and maintenance.

The experiences of many woodworking plants with carbides have proved beyond doubt that greater-volume production and superior-quality work can be achieved at less cost. This statement does not overlook the poor results which some firms have experienced within their own plants. On the other hand, poor results often highlight the need for stabilized operational procedure. These procedures must be based on fundamental mechanical laws that will apply to production sawing operations.

The paper also states the following: (1) Consult competent saw and machinery engineers, submitting complete information. (2) Good glue-line sawing is well established. (3) Smooth, accurate cut-off and trimmer sawing is well developed. (4) Higher arbor speeds and better feed control are needed. (5) Tension problem may be minimized or eliminated. (6) A solution to the problem of maintenance of carbide tools has been outlined. (7) Gang sawing of better quality at lower saw-maintenance cost is a strong possibility. (8) "Cut control" safety-type saws are generally accepted for hand-feed types of machines.

Materials Handling

Belt Conveyers—Industry's Bulk-Handling Giant, by L. O. Millard, Link-Belt Company, Chicago, Ill. 1951 ASME Annual Meeting paper No. **51—A-150** (mimeographed).

BELT conveyers are capable of handling tonnages in excess of any currently practical requirement. They can transport such tonnages dependably, over greater distances and at lower costs per ton than any other type of conveyer, and often at lower cost than any other form of transportation.

In American industry there is an increasing need for conveyer systems to transport the millions of tons of ore, coal, stone, and other bulk materials consumed each year.

While belt conveyers stand alone in their mechanical ability to meet the demand for higher-capacity bulk-handling conveyers, they are also the most economical to operate. Power and maintenance costs are quite low. They are most dependable, yet they can be repaired quickly when necessary.

Furthermore, as annual tonnage requirements increase, the over-all operating costs of belt conveyers become more favorable when compared with other types of conveyers and other means of bulk transportation for which belts are suited.

Today, it is difficult to imagine any other practical means of handling coal at the rate of 1500 to 2000 tons per hr, required at several of the new central power stations, or of 6000 to 8000 tons per hour of ore in mining or dock operations.

This paper reviews a selected group of installations which illustrate the reasons why belt conveyers have gained their currently dominant place in the bulk-handling field.

Applied Mechanics

Supersonic Flow With Variable Specific Heat, by F. P. Durham, University of Colorado, Boulder, Colo. 1951 ASME Annual Meeting paper No. **51—A-13** (in type; to be published in the *Journal of Applied Mechanics*).

FORMULAS are developed for stagnation conditions and one-dimensional flow through shock waves, including Rankine-Hugoniot values, taking into account the variation of the specific heat of air with temperature by means of the concept of mean specific heats. These formulas are reduced to correction factors that may be applied to the widely used constant specific-heat formulas up to a Mach number of 7. The corrections involved are appreciable in the case of the density change through a shock wave and for the total pressure ratio across a shock wave, as well as for stagnation pressures and temperatures. The limitations imposed by the deviation of a gas at high pressure from the ideal equation of state, relaxation time, and dissociation are discussed.

A New Method of Calculation of Reheat Factors for Turbines and Compressors, by Joseph Kaye, Jun. ASME, and K. R. Wadleigh, Massachusetts Institute of Technology, Cambridge, Mass. 1951 ASME Annual Meeting paper No. **51—A-2** (in type; to be published in the *Journal of Applied Mechanics*).

A SIMPLE method is presented for rapid accurate calculation of reheat factors for adiabatic turbines and compressors with an infinite number of stages. The method is limited to fluids for which the equation of state, $pv = RT$, is adequate, and for which the specific heat is a function of temperature only. The method is based upon the concept of the step efficiency—the efficiency of an infinitesimal stage based on the reversible adiabatic work—and upon the concept of the relative pressure function. The method is used to produce charts of reheat factors for turbines and compressors for several gases. A theoretical justification is given for empirical rules of thumb which have been widely used to predict reheat factors for turbines and compressors with a finite number of stages.

A Contribution to the Theory of the Development and Stability of Detonation in Gases, by A. K. Oppenheim, Mem. ASME, University of California, Berkeley, Calif. 1951 ASME Annual Meeting paper No. **51—A-23** (in type; to be published in the *Journal of Applied Mechanics*).

THE development of detonation of an explosive gas mixture contained in a constant-cross-section duct is analyzed on the basis of a unidimensional, gas-dynamic treatment of a double-discontinuity combustion system. A steady and an unsteady system are considered, and it is shown that the latter yields an adequate explanation of the effect of coalition of the two discontinuities on establishment and subsequent stability of the detonation wave. The locus of states behind the detonating combustion zone during the development of the process is determined and analyzed.

An Alternative Formulation of the Laws of Mechanics, by H. M. Trent, Naval Research Laboratory, Washington, D. C. 1951 ASME Annual Meeting paper No. **51—A-30** (in type; to be published in the *Journal of Applied Mechanics*).

THE author proposes a set of laws of mechanics which are duals of those of Newton. These laws are based upon the concept of the continuity of transmitted forces around closed loops. They are particularly useful in those engineering problems where only knowledge of forces is of interest, since the laws lead directly to equations in which forces are the dependent variables.

A Variational Principle for the Mesh-Type Analysis of a Mechanical System, by R. A. Toupin, Naval Research Laboratory, Washington, D. C. 1951 ASME Annual Meeting paper No. **51—A-19** (in type; to be published in *the Journal of Applied Mechanics*).

THE mesh-type equations for a dynamical system consisting of N-mass points are derived from the Newtonian form of the equations of motion. The appropriate Lagrangian for a variational principle is established for these equations.

On the Direction of Fatigue Cracks in Polycrystalline Ingot Iron, by F. A. McClintock, Jun. ASME,* Massachusetts Institute of Technology, Cambridge, Mass. 1951 ASME Annual Meeting paper No. **51—A-9** (in type; to be published in the *Journal of Applied Mechanics*).

A STATISTICAL analysis is developed to show how a microscopic shear failure can result in the apparent tensile failure of polycrystalline iron in rotary bending fatigue tests.

A Statistical Distribution Function of Wide Applicability, by Waloddi Weibull, Royal Institute of Technology, Stockholm, Sweden. 1951 ASME Annual Meeting paper No. **51—A-6** (in type; to be published in the *Journal of Applied Mechanics*).

THIS paper discusses the applicability of statistics to a wide field of problems. Examples of simple and complex distributions are given.

The Time Required for Constant-Volume Combustion, by A. S. Campbell, Jun. ASME, University of Maine, Orono, Me. 1951 ASME Annual Meeting paper No. **51—A-15** (in type; to be published in the *Journal of Applied Mechanics*).

BY combining the results of an elementary thermodynamic analysis of the temperature distribution in the burned gases of a constant-volume bomb with an examination of the velocity relations at the flame front, it is possible to relate the "normal burning velocity" to the time rate of production of burned gases. Integration of this equation leads to an estimate of the time required for the combustion process.

Measurement of Recovery Factors and Friction Coefficients for Supersonic Flow of Air in a Tube, by J. Kaye, Jun. ASME, J. H. Keenan, Fellow ASME, T. Y. Toong, Massachusetts Institute of Technology, Cambridge, Mass.; K. K. Klingensmith, Jun. ASME, United Aircraft Corporation, East Hartford, Conn.; and G. M. Ketchum, Jun. ASME, General Electric Company, Schenectady, N. Y. 1951 ASME Annual Meeting paper No. **51—A-29(*a*)** (in type; to be published in the *Journal of Applied Mechanics*).

FOR the past few years a program has been under way to obtain reliable data on the rate of heat transfer to air moving at supersonic speeds. The investigation

was limited to air flowing at supersonic speeds in a round tube. The program was divided into two separate parts, the first for measurement of the adiabatic wall temperatures of a supersonic stream, and the second for the heat-transfer rate. The first part of this program is described here. The details of three experimental test combinations used to measure the adiabatic wall temperature and local state of a supersonic stream of air are presented. The experimental data for 40 runs, in the form of measured pressure and temperature distributions, are included. The range of diameter Reynolds number covered is from 0.15×10^5 to 5×10^5. The length Reynolds number extends to 120×10^5. The Mach number at the inlet to the round tube is about 2.6. The calculated quantities such as the local apparent friction coefficient, recovery factor, local Mach number, and so forth, are obtained from the simple one-dimensional flow model for which the properties of the stream are uniform at any cross section of the tube and boundary-layer effects are ignored. A subsequent paper deals with the calculation of these quantities when account is taken of the boundary-layer growth in the tube on the basis of a two-dimensional flow model.

Measurement of Recovery Factors and Friction Coefficients for Supersonic Flow of Air in a Tube, by J. Kaye, Jun. ASME, T. Y. Toong, and R. H. Shoulberg, Massachusetts Institute of Technology, Cambridge, Mass. 1951 ASME Annual Meeting paper No. **51—A-29(*b*)** (in type; to be published in the *Journal of Applied Mechanics*).

THE first part of a program to obtain reliable data on the rate of heat transfer to air moving at supersonic speeds in a tube has been devoted to measurements made on adiabatic supersonic flow of air in a tube. The details of these measurements have been described in a previous paper. The calculated quantities such as the local apparent friction coefficient, recovery factor, Mach number, and so forth, were obtained from the simple one-dimensional flow model for which the properties of the stream are uniform at any section, and boundary-layer effects are ignored. The analysis of some of the same data given in the previous paper is undertaken here with the aid of a simplified two-dimensional flow model. The supersonic flow in the tube is divided into a supersonic core of variable mass with the fluid remaining in the core undergoing a reversible adiabatic change of state, and a laminar boundary layer of variable mass. The compressible laminar boundary layer increases in thickness in the direction of flow, and then undergoes a transition to a turbulent boundary layer. The two-dimensional flow model is limited here to the region where a laminar boundary layer appears to be present in the entrance region of the tube. The results of the analysis based on the two-dimensional flow model indicate that where the flow in the tube boundary layer appears to be laminar, the measured pressures and temperatures in the tube for adiabatic supersonic flow of air could have been predicted, with sufficient accuracy for engineering problems, from measured data for supersonic flow of air over a flat plate with a laminar boundary layer, and with zero pressure gradient.

Gas Cooling of a Porous Heat Source by Leon Green, Jr., Jun. ASME, North American Aviation, Inc., Downey, Calif. 1951 ASME Annual Meeting paper No. **51—A-32** (in type; to be published in the *Journal of Applied Mechanics*).

A LIMITING case of solid-fluid heat transfer is examined, in which a gas passes through a porous wall of high specific surface with heat generation within the solid material. Dimensionless temperature profiles in the wall are presented in terms of the rate of heat generation, rate of flow, and thermal properties of the gas and solid. The pressure drop across the wall is approximated by using an average wall temperature and assuming isothermal conditions. Temperature profiles, pressure drops, and pumping-power/power-output ratios are calculated for the hypothetical case of a heated graphite wall cooled by helium. It is found that the thermal dependence of the gas viscosity produces a minimum in the pressure-drop versus flow-rate curve, and it appears that favorable pumping-power/power-output ratios can be obtained by the use of high pressures. The problem of temperature stability in a gas-cooled porous solid is pointed out and the need for experimental work emphasized. Use of the sweat-cooling technique for high-pressure, high-temperature ducts is suggested.

The Theoretical Analysis of Metal-Forming Problems in Plane Strain, by E. H. Lee, Mem. ASME, Brown University, Providence, R. I. 1951 ASME Annual Meeting paper No. **51—A-8** (in type; to be published in the *Journal of Applied Mechanics*).

THE plastic flow in plane strain of an ideally plastic material subjected to large strains is considered. Elastic strains are negligible and a rigid-plastic type of analysis is adopted. The equations to be satisfied are detailed, and they include stress and velocity equations in the plastic regions, as well as consideration of the stress field in the rigid regions to check the validity of small strains there. Complete solutions satisfying these conditions require the determination of the rigid-plastic boundaries to delineate the regions in which the various conditions must be satisfied. The fallacy of static determinacy of such problems in terms of the stress equations only is emphasized. The study of complete solutions indicates errors in solutions commonly accepted in the literature which are based on the stress equations only. Examples are discussed. The general occurrence of velocities in the boundary conditions of forming problems is pointed out, and the difficulty of setting such problems in terms of boundary stresses only is illustrated by examples.

An Electrical Method for Determining Journal-Bearing Characteristics, by D. S. Carter, Princeton University, Princeton, N. J. 1951 ASME Annual Meeting paper No. **51—A-27** (in type; to be published in the *Journal of Applied Mechanics*).

MORE than half a century has passed since Osborne Reynolds employed hydrodynamic principles to derive his well-known differential equation for the pressure distribution in a thin film of viscous fluid under shear. During that time many ingenious methods have been put forward for the solution of Reynolds equation in cases of engineering interest. These methods have been found useful in the few cases to which they have been applied; but none is adaptable to the production, in quantity, of much-needed data. Any future program for the preparation of a comprehensive set of bearing data will surely be carried out with the help of the large, modern, rapid-calculating machines. Until these machines become more readily available, however, the need will remain for improved calculational techniques which require only modest financial and material resources. It was with this need in mind that the work described in the present paper was undertaken.

The Calculated Performance of Dynamically Loaded Sleeve Bearings—III, by J. T. Burwell, Massachusetts Institute of Technology, Cambridge, Mass. 1951 ASME Annual Meeting paper No. **51—A-7** (in type; to be published in the *Journal of Applied Mechanics*).

IN parts I and II of this series, the performance of dynamically loaded sleeve

bearings was calculated neglecting the transverse flow in the oil film, i.e., the bearing was assumed to be wide compared to its diameter, and then side-leakage factors based upon constant-load calculations were applied. In the present paper the performance is calculated for bearings assumed to be so narrow that film flow due to pressure in the direction of motion can be neglected. In this case the dependence upon bearing width appears explicitly and no side-leakage factors are required. Conclusions about the performance of the bearing under various simple types of loading are drawn. The two solutions for the limiting cases of very wide and very narrow bearings are compared and found to be qualitatively similar. From this it is concluded that bearings of arbitrary width should show the same qualitative behavior. Finally, the present solution is compared with exact calculations for certain narrow bearings, and the error involved in the present approximation is thereby determined.

Hydraulics

Flow Through Two Orifices in Series, by W. M. Rohsenow, Jun. ASME, Massachusetts Institute of Technology, Cambridge, Mass.; C. H. Fink, Commander, USN, New York Naval Shipyard, Brooklyn, N. Y.; and S. R. Pollis, Lieut. Commander, Brazilian Navy, Rio de Janeiro, Brazil. 1951 ASME Annual Meeting paper No. **51—A-87** (mimeographed).

THE flow characteristics of two orifices in series were investigated. Under certain conditions a pressure rise across the second orifice is experienced. Consequently, a double orifice can be devised which will have the same measuring head as a single orifice but will have greater pressure recovery.

The single orifice has long been used as a flow-measuring device. Associated with the flow through such an orifice is a pressure drop across it which serves as the "measuring" head Z_m, and an unrecovered head Z_l. The present investigation was undertaken to study the performance characteristics such as flow coefficients and the relation between Z_m and Z_l for a system composed of two axially coincident orifices in series.

Measurement of Hydraulic-Turbine Vibration, by John Parmakian, Mem. ASME, and Richard S. Jacobson, U. S. Bureau of Reclamation, Denver, Colo. 1951 ASME Annual Meeting paper No. **51—A-88** (mimeographed).

THIS paper describes a test program used to measure and eliminate the vibration which had produced extensive cracking in the blading of a slow-speed, 40,000-hp, hydraulic turbine. Strains, accelerations, and pressures were measured at various locations on the turbine runner while the unit was in operation. The instruments used for these measurements were of the resistance type. Instrument signals were transmitted through collector rings and brushes to direct-writing oscillographs. The vibration was successfully eliminated by an inexpensive modification of the runner blading which is described in the paper.

Fluid Meters

Discharge Coefficients of Herschel-Type Venturi Tubes, by A. L. Jorissen, Mem. ASME, Cornell University, Ithaca, N. Y. 1951 ASME Annual Meeting paper No. **51—A-56** (in type; to be published in Trans. ASME).

AN analysis has been made of a large number of calibration curves of Herschel-type Venturi tubes, in order to obtain average values of the coefficient of discharge, both in the range of constant coefficient and of coefficient varying with Reynolds number. The data furnished by American practice have been compared with foreign standards of flow measurement.

Discharge Measurements by Means of Cylindrical Nozzles, by A. L. Jorissen, Mem. ASME, Cornell University, Ithaca, N. Y., and H. T. Newton, The Pennsylvania State College, State College, Pa. 1951 ASME Annual Meeting paper No. **51—A-63** (in type; to be published in Trans. ASME).

CYLINDRICAL nozzles maintain a constant coefficient of discharge at Reynolds numbers lower than standard pressure-difference devices of flow measurement. Tests on nozzles of various opening ratios have indicated the optimum proportions for each ratio.

Orifice and Flow Coefficients in Pulsating Flow, by Newman A. Hall, Mem. ASME, University of Minnesota, Minneapolis, Minn. 1951 ASME Annual Meeting paper No. **51—A-149** (mimeographed)

THE primary experimental problem in nonsteady flow measurement is that of pressure measurement. This will involve either instantaneous pressure differentials for transient flow or mean pressure differentials for mean flow. The conventional differential pressure gage installation is recognized as deficient in general. However, there is no basic reason why modifications cannot be made to provide satisfactory readings. Recent studies have indicated in part some of the characteristics which must be considered. It is sufficient to realize that the pressure-measuring system when applied to nonsteady flow is no longer a static equilibrium system. Consequently the dynamic actions within the pressure tap, leads, connections, and gage itself must be sufficiently well understood in order to make predictions and set up installation specifications. This information is essential for the usual liquid manometer obtaining mean pressures and also for any of the several types of electrical or electronic instantaneous pressure pickups. In general, it is not practical to obtain a direct local pressure reading on any type of gage or pickup. The effect of the local pressure must be transmitted in some manner and the behavior of this transmission system remains a problem.

Progress Report on the Study of Supercompressibility Factors for Natural Gases, by Richard H. Zimmerman and Samuel R. Beitler, Fellow ASME, Ohio State University, Columbus, Ohio. 1951 ASME Annual Meeting paper No. **51—A-153** (mimeographed).

A REPORT is given on the present status of an evaluation of supercompressibility factors of natural gases. The aim of the research work is an attempt to establish an accurate method for the prediction of these factors within the presure range 0 to 4000 psi and in terms of gas properties generally known or conveniently determined. The working method used to predict supercompressibility factors is based on the method proposed by Dunkle in 1944. Results of the method are compared with supercompressibility factors experimentally determined on the Burnett deviation apparatus.

Railroads

Railroads and Highway Trailers, Economic Aspects, by E. F. Ryan, Rail-Trailer, Inc., Evanston, Ill. 1951 ASME Annual Meeting paper No. **51—A-151** (mimeographed).

THIS paper brings out the rapidly increasing transportation of LCL traffic by highway vehicles and the corresponding decline of this traffic on railroads. The related revenue factors are given. There is discussion of the disadvantages of both truckers and railroads of long-haul highway movements and the corresponding advantages to both industries that can be achieved by co-ordinating

the two types of equipment. Using highway trailers to perform the terminal services, transporting them on railroad flatcars from city to city allows each of the transportation agencies to function in its most effective sphere. The paper shows that the utilization of freight cars in such movements is much greater than that of the average freight car and that as a consequence the annual revenue per car can be several times that of the average car. Actual operating statistics are included.

An Economic Study of Roller Bearings on Freight Cars, by O. J. Horger, Fellow ASME, The Timken Roller Bearing Company, Canton, Ohio. 1951 ASME Annual Meeting paper No. 51—A-152 (mimeographed).

A PROGRESS study is presented on the costs of maintenance and operation of plain bearings and roller bearings on freight-car journal boxes. Cartridge roller-bearing applications are proposed providing one design of journal-box assembly for each axle capacity, which will fit into any of the existing trucks now in service. A jaw-type side frame is proposed for new cars, which will receive this same journal box and at lower cost, as well as offering quick wheel-change features. An axle journal design based on fatigue tests of full-size members is shown which can be standardized to receive the bearings of various manufacturers.

This analysis shows a saving of $6.49 per 1000 car-miles for the roller-bearing over the plain-bearing-equipped freight car. If roller bearings were applied on all freight cars in the United States at an increased net capital investment of about $871 million the return on this investment would be 22 per cent after depreciation and interest charges. This would permit recovery of the investment after 4.57 years. Other advantages of roller bearings, not subject to dollar evaluation, are also presented.

History and Development of the 567 Series General Motors Locomotive Engine, by E. W. Kettering, General Motors Corporation, LaGrange, Ill. 1951 ASME Annual Meeting paper No. 51—A-72 (mimeographed).

THIS paper covers the development of the 567 series General Motors Diesel locomotive engine. Early history of gasoline and Diesel engines as applied to railroad use is given. Future developments by GM are also included. For a more detailed abstract of this paper see "567 Series Diesel Engine" on pages 140–143 of the "Briefing the Record" section of this issue.

Industrial Instruments

Analysis of Some Hydraulic Components Used in Regulators and Servomechanisms, by S. Z. Dushkes, Askania Regulator Company, Chicago, Ill., and S. L. Cahn, North American Aviation, Downey, Calif. 1951 ASME Annual Meeting paper No. 51—A-22 (in type; to be published in Trans. ASME).

HYDRAULIC servomechanisms have come into wide use in recent years as a result of the low inertia of hydraulic servomotors compared to electric servomotors of the same power rating. This paper discusses the theory of operation, static characteristics, and dynamic characteristics of some hydraulic components that have been used for many years in regulator applications. Previously, the dynamics of these components were not of great importance because of the slowness of the processes controlled. The important considerations were static gain and static accuracy. The dynamic characteristics have been investigated more recently as a result of the high dynamic-performance demands of servomechanism applications. Dynamics are considered from the frequency-response approach.

How to Obtain Instrument Accuracy With Proportioning Pumps, by J. N. Swarr, Mem. ASME, Corn Products Refining Company, Chicago, Ill. 1951 ASME Annual Meeting paper No. 51—A-53 (in type; to be published in Trans. ASME).

PROPORTIONING pumps can be used as flow-rate controllers to good advantage, if the stroke and speed are known and controllable, and if the volume discharged by the pump is equal to its displacement. The discharge may be greater or less than the displacement, depending upon the relationships between such parameters as rate of plunger displacement, friction losses in the suction-side and discharge-side piping, masses of liquor in both the suction and discharge lines which must be accelerated and decelerated at each stroke, elevations of supply and discharge tanks, and so forth. The relationships between these factors, as they affect pump volumetric performance, are developed on a theoretical basis, and simple tests are devised which will enable an engineer to predetermine whether or not a proposed installation will be satisfactory, and which indicate what changes must be made to correct an unsatisfactory design. The conclusion is drawn that the range of conditions under which a proportioning pump will give satisfactory performance as a meter is considerably restricted so that a careful and thorough analysis of each proposed installation is essential.

Frequency-Response Analysis for Industrial Automatic Control Systems, by D. W. St. Clair and W. F. Coombs, Jr., Eastman Kodak Company, Rochester, N. Y., and W. D. Owens, Minneapolis-Honeywell Regulator Company, Minneapolis, Minn. 1951 ASME Annual Meeting paper No. 51—A-127 (mimeographed; to be published in Trans. ASME).

A NEED exists in the industrial automatic control field for a more exact method of control analysis than the currently used empirical and rule-of-thumb methods, and which at the same time can be understood by more than a few. Such a method is available and is called frequency-response analysis. This versatile and powerful method of study was originally and thoroughly developed for use in feedback amplifier design and subsequently has been widely applied in the servomechanism field. It is now generally realized that servomechanisms and industrial automatic-control systems are basically the same and, therefore, the methods of study used in one field can be applied directly to the other merely by a change in terminology and point of view or emphasis.

This paper outlines the fundamental principles of frequency-response analysis in terms familiar to the industrial automatic-control engineer and presents data obtained by frequency-response methods descriptive of the effect of typical variables on the behavior of the control system. These variables are gain, derivative time, reset rate, transportation lag, and capacity lag, with period of oscillation and stability as dependent variables.

They have been combined to form three basic controllers and four basic processes, the data being presented for the various combinations of controller and processes. The method of calculation and a specific example are given in the appendix.

Heat Transfer

Heat Transfer by Gas Conduction and Radiation in Fibrous Insulations, by J. D. Verschoor, Jun. ASME, and Paul Greebler, Johns-Manville Research Center, Manville, N. J. 1951 ASME Annual Meeting paper No. 51—A-54 (in type; to be published in Trans. ASME).

THERMAL conductivity measurements were made on samples of an ex-

perimental glass fibrous insulation ranging in density from 0.5 to 8.4 pcf. Tests were carried out at atmospheric pressure with four different gases in the insulation samples, and the thermal conductivity with air was studied over a pressure range of 1 micron to 760 mm of Hg. Gas conduction is the most important mechanism of heat transfer. A theory of gas conduction in fibrous insulations was developed, and agrees well with experimental results. Theoretical considerations of heat transfer by radiation were confirmed by the experimental thermal-conductivity values at low pressures. Methods are discussed of producing considerable reduction in the thermal conductivity of fibrous insulations.

Heat Transfer From Spheres to a Rarefied Gas in Supersonic Flow, by R. M. Drake, Jr., and G. H. Backer, University of California, Berkeley, Calif. 1951 ASME Annual Meeting paper No. **51—A-55** (in type; to be published in Trans. ASME).

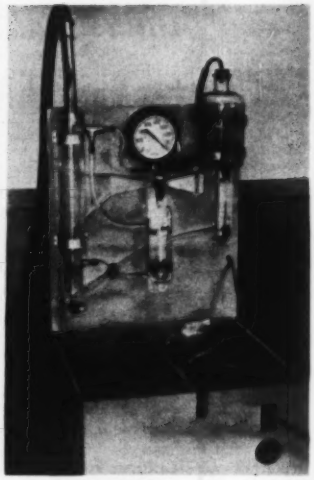
AN approximate analysis is presented for the prediction of the over-all average heat-transfer coefficients from spheres to air in the transition-flow region, that region wherein the mean free molecular path is small but not negligible when compared with the sphere diameter. The analysis is made on the basis of a simplified flow field and the utilization of the continuum formulation of the energy equation with the rarefaction effects being accounted for entirely in the boundary conditions. The results of the analysis are compared with experimental heat-transfer data from sphere to air in the transition-flow region, with heat-transfer data from spheres to air in the continuum-flow region, and with the calculated results of heat transfer from spheres in the free molecule-flow region. Experimental free-stream recovery factors are presented for spheres. Significant flow parameters and flow-region limits for the transition region are discussed.

Process Industries

Air Pollution and the Mechanical Engineer, by F. G. Sawyer, Stanford Research Institute, Stanford, Calif. 1951 ASME Annual Meeting paper No. **51—A-76** (mimeographed).

THE many unsolved problems involved in ridding our urban areas of polluted air will call upon the special talents of engineers, chemists, meteorologists, and politicians. The mechanical engineer, in particular, is faced with the challenge of designing better and cheaper gas and particle recovery systems.

Research at Stanford Research Institute



PORTABLE VENTURI SCRUBBER

(Adapted from the large-scale commercial unit, this portable research instrument is useful for collecting particulate matter from large volumes of air.)

shows that the burning of nearly 50,000 tons a day of fuels and rubbish is the principal cause of smog in Los Angeles County. Of the total combustion and evaporation products put into the air daily, about 40 per cent come from industrial sources and 60 per cent come from activities of the general public. An important example of the latter is the exhaust from automotive engines. Research needs to be done to reduce this pollution.

In the future, more industrial plants must consider air-pollution potential as a factor in plant location. More stringent air-pollution legislation is on the way. Industry must be ready for it.

Metal Cutting

The Mechanics of Three-Dimensional Cutting Operations, by M. C. Shaw, Mem. ASME, N. H. Cook, and P. A. Smith, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1951 ASME Annual Meeting paper No. **51—A-61** (in type; to be published in Trans. ASME).

THE oblique tool, which has a cutting edge that is inclined to the direction of motion of the workpiece at an angle other than 90 deg, represents the most general type of cutting tool. The more complex three-dimensional tools of production may be related to an equivalent oblique tool having a given inclination angle and a corresponding effective rake angle. In this investigation the chip-flow direction and the velocity and force relations for an oblique cutting tool were compared with experimental results. The angle between the direction of chip flow and normal to the cutting edge was found to be approximately equal to the inclination angle for ordinary friction conditions, but to be progressively larger than the inclination angle as the friction decreased. The effective rake angle for an oblique tool is found to increase without a corresponding increase in the included angle. The direction of the force component in the tool face was found to deviate considerably from the chip-flow direction, particularly for larger values of inclination angle. However, the directions of maximum shear stress and shear strain on the shear plane were found to be nearly collinear for values of inclination up to 30 deg. The analytical consequences of these observations are discussed. The method of applying the oblique-tool results to three-dimensional tools is illustrated by three examples involving a lathe tool, a face-milling cutter, and a drill point. The drill-point discussion is extended to illustrate the value to be derived from a qualitative application of basic oblique-tool mechanics to the interpretation of drill test data.

The Rotary Cutting Tool, by M. C. Shaw, Mem. ASME, P. A. Smith, Mem. ASME, and N. H. Cook, Massachusetts Institute of Technology, Cambridge, Mass. 1951 ASME Annual Meeting paper No. **51—A-62** (in type; to be published in Trans. ASME).

A NOVEL lathe-type cutting tool in the form of a disk that may be rotated about its central axis is described and analyzed. Such a rotary tool is found to correspond to an equivalent oblique tool having an angle of inclination whose tangent is equal to the ratio of the tool and work-surface velocities. In addition to the inherent feature of the oblique tool of providing a greater effective rake angle without a corresponding decrease in the actual included angle of the tool, the rotary tool (1) provides a rest period for the cutting edge, thus enabling the edge to be cooled and the adsorbed film on the tool surface to be replenished between cuts; (2) enables the relative chip velocity to be increased to provide a lower coefficient of friction without necessitating a corresponding increase in the rate of metal removal. A rotary tool of 10 deg rake angle is capable of reducing total power required to make a given cut by about 30 per cent and at the same time to operate with a temperature about 400 F lower than that for the equiva-

lent stationary tool. Representative test data for both rotary and stationary tools are analyzed and discussed. The shear stress on the shear plane is found to decrease with increased shear strain in the case of either a rotary tool or an oblique tool. This anomalous result is explained in terms of a size effect associated with the change in thickness of the shear plane that accompanies a change in the angle of inclination.

Plastics

Effect of Velocity on Tensile Impact Properties of Polymethyl Methacrylate, by Bryce Maxwell, Jun. ASME, and J. P. Harrington, Princeton University, Princeton, N. J. 1951 ASME Annual Meeting paper No. **51—A-65** (in type; to be published in Trans. ASME).

THE history of impact testing of plastics is reviewed and the current theories of impact resistance are discussed. The effect of velocity on the energy absorbed by polymethyl methacrylate at various temperatures has been studied with the aid of two new testing machines. The results are interpreted in terms of the classical theories of mechanics of materials and the current theories of the rheology of high polymers. It is concluded that there are two distinct critical velocities of straining in this material—the lower one corresponding to the relaxation of the bonds restraining chain-chain slipping and the higher one corresponding to the relaxation of the secondary bonds involved in chain uncoiling. Both of these relaxations are temperature-dependent—the lower one to a slight extent and the upper one to a marked extent. Above the two critical velocities the response of the material is purely elastic. A method of calculating the energy to break at rates of straining above the second critical velocity from the slow-rate stress-strain curves is demonstrated.

Metals Engineering

Determination of Principal Plastic Strains, by W. E. Cooper, Jun. ASME, Purdue University, West Lafayette, Ind. 1951 ASME Annual Meeting paper No. **51—A-128** (mimeographed).

EXPERIMENTAL studies in the field of plasticity necessitate the measurement of finite strains. One of the strain-indicating devices for this purpose is known as photogrid and consists of a grid applied photographically to the surface of the specimen. This method is particularly well adapted to cases in which it is impractical to use a strain-indicating device which projects from the surface. Also, the grid is resistant to forming lubricants up to approximately 600 F and, if lubricated, will withstand many of the common forming processes. The range of strain which may be measured has been given as 275 per cent but is often established by such metallurgical factors as "orange peel" effect rather than the failure of the grid itself.

A method is presented whereby the principal plastic strains, and their directions, may be determined from photogrid data in the case when the grid is not necessarily in alignment with the principal strain directions. The accuracy of the method is dependent upon the ability to measure accurately the spacing of the grid. For many purposes it will be possible to design the specimen and grid to suit available comparators and provide the desired accuracy. For certain tests the method provides a usable technique for cases in which no other method is available. One such case would be the forming of sheet material when the direction of the principal strains could not be predicted.

Textile Industry

Opening and Picking by the Whitin System, by Paul C. Grant, Jr., Whitin Machine Works, Whitinsville, Mass. 1951 ASME Annual Meeting paper No. **51—A-67** (mimeographed).

BECAUSE of the advance of newer and better methods of drawing, roving, spinning, and weaving; because of the loss of doublings in the mills; and because of machine-picked cotton and so-called improved ginning, the mills are demanding a better-quality product from preparatory machinery to obtain better quality and evener laps from pickers. The quality of the finished product in a mill depends on the quality and evenness of the lap that is creeled on the back of the card. Little can be done in the subsequent operations to overcome poor-quality laps; consequently, it is more important than ever before that the lap be thoroughly cleaned and uniform in weight per unit of length.

As a machine manufacturer, Whitin has realized that the real scientific knowledge gained by research in the past few years in the roving, spinning, and weaving fields has far outstripped the preparatory machinery and left it in an untenable position. Consequently, the company is now engaged in a program of intense scientific research on blending, opening, cleaning, and lapping cotton. Research has disclosed some astounding facts and while it is premature to disclose the findings, it is felt that in the near future the whole concept of cleaning cotton will be radically changed. Thus far the research indicates that heavy high-velocity beaters are not only unnecessary but are actually detrimental to quality processing. It also indicates that the number of machines required to clean cotton can be reduced materially and that less damage to the fiber, and consequently, fewer potential neps will result. The scientific application of proved principles of aerodynamics, and a limited use of air streams for conveying purposes both in the machines and pipe lines will result in an improved lap of cleaner fibers with fewer potential neps to present to the cards.

ASME Transactions for January, 1952

THE January, 1952, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

TECHNICAL PAPERS

Damage Prevention From Diesel Engine Crankcase Explosions, by A. C. Cavileer. (51—OGP-3)

Diesel Engine Crankcase-Explosion Investigation, by G. W. Ferguson. (51—OGP-2)

Electric Control of Air-Flow Porosity in Plastic Sheet Materials, by J. J. Suran. (51—SA-2)

Effect of Orientation on the Mechanical Properties of Polystyrene, by R. G. Cheatham and A. G. H. Dietz.

Effect of Absorbed Water on the Physical Properties of Phenolic Plastics, by H. M. Quackenbos, Jr., and J. M. Hill.

Forces in Dry Surface Grinding, by E. R. Marshall and M. C. Shaw. (51—SA-8)

The Size Effect in Metal Cutting, by W. R. Backer, E. R. Marshall, and M. C. Shaw. (51—SA-9)

Surface Temperatures in Grinding, by J. O. Outwater and M. C. Shaw. (51—SA-10)

Centrifugal Jet-Pump Combinations, by J. W. McConaghy. (51—SA-27)

Nondimensional Compressor Performance for a Range of Mach Numbers and Molecular Weights, by H. E. Sheets. (51—SA-19)

Effect of Taper on Screw-Thread Load Distribution, by E. E. Stoeckly and H. J. Macke. (51—S-15)

Catalytic Effect of Several Metals on the Oxidation of Lubricating Oils, by D. W. Sawyer. (51—SA-3)

Piping Flexibility Analysis by Model Test, by Lale C. Andrews. (51—SA-24)

Stress Conditions in Flanged Joints for Low-Pressure Service, by E. O. Waters and F. S. G. Williams. (51—SA-4)

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Experiences With Synthetic Lubricants

COMMENT BY J. E. BROPHY[1] AND W. A. ZISMAN[2]

This paper[3] contains a valuable summary of experience with the much discussed polyglycols derivatives of the Carbide and Carbon Chemicals Corporation. The case-history method used is especially valuable and instructive to engineers interested in maintenance and operation problems. The authors have shown admirable restraint and clarity in organizing their information.

Our own experience during World War II confirmed the claims by the authors of the valuable properties of the LB and HB fluids as hydraulic fluids. We are surprised that they have not said something about the related DLB fluids which our own postwar experiences have shown are particularly promising for a variety of applications where both high VI and low pour point are required.

It is not widely known how far ahead the Carbide and Carbon Chemicals Corporation was of the Germans in developing suitable polyethers for lubricants. German work on tetrahydrofuran polymers is closely related, but is much less advanced than the American development.

In discussing the various installation which failed badly when petroleum products were used, it is desirable to know the temperature of the bearing involved. In the case of a fan circulating air at 630 F, carbon deposits were suggested as the cause of high wear in the bearing. It has not been made clear whether grease or oil was used in these bearings. However, other research has shown that insufficient available fluid at the critical periods causes rapid failure in ball bearings lubricated with greases, and the carbon deposits are a consequence. It would seem in this instance that one virtue of the LB fluid is that the degradation products are volatile.

In the discussion concerning lubrication of gears, it was suggested that the LB lubricants have some wear preventive action which makes them superior to petroleum oils. This does not seem to be supported completely by the data given in the paper. The LB lubricants used contain oxidation inhibitors and no proof has been given that they decrease gear wear. On the other hand, as the oxidation products are acids, they might serve as wear preventives. It does not seem sound to compare the nonadditive SAE 30 motor oils with the oxidation-inhibited LB lubricants. We do not question their results but doubt their explanation.

It is stated that additives may perform differently in polyalkylene-glycol derivatives than in mineral oils. Has this difference been established with several types of additives?

In the discussion of vane pumps, the authors did not indicate the type used, but we presume from the illustrations given that they are referring to the Vickers vane pump. Early in World War II our own work showed that the vane pump is an excellent machine for observing and predicting wear-preventive properties of oils, since all of the lubricants we have studied required some wear preventive to function satisfactorily in it. Since the LB and HB lubricants function well in this pump, it is excellent evidence that they will function well under many conditions requiring a mild wear-preventive additive in the oil. The vane pump is sensitive to the viscosity of the fluid being pumped. This raises the question of comparability in the operating temperature of the viscosity of the petroleum fluid and the LB fluid.

We doubt that the LB and HB fluids are more stable to either heat or atmospheric oxidation than the equivalent inhibited petroleum. These polyalkylene-oxide derivatives are not more stable thermally than paraffinic hydrocarbons and are less stable to atmospheric oxidation, but they can be and are well inhibited by the manufacturer against atmospheric oxidation. That this has been accomplished is well evidenced by the data presented. When the LB and HB fluids oxidize, the products are volatile acids and aldehydes which escape, and other products which remain dissolved in the oil without the formation of precipitates or varnishes as normally occurs. The fluids are also excellent solvents and that may be contributory to their self-detergent property. We suggest that the excellent performance at high temperature reported by the authors is due to the freedom of the synthetic oils from varnishes and sludges and not because they do not "crack" or oxidize.

The wear-preventive property discussed briefly by the authors largely results from the fact that the LB and HB fluids oxidize to perform wear-preventive material. Hence it is inconsistent to claim that they are free from oxidation at high temperature. The wear-preventive aspects are interesting and, in our opinion, they deserve much more research than has been reported to date. We believe there will be found an intimate relationship between the antiwear properties of these polyethers and the nature of the oxidation products formed.

The authors' presentation has been a convincing evidence that these new synthetic lubricants are obtaining wide recognition as a valuable class of industrial lubricants. With them we believe that these and other new synthetic lubricants will continue to prove invaluable in adding to our knowledge about the principles and practices of lubrication.

COMMENT BY E. M. KIPP[4]

While our own investigation of, and industrial experiences with these types of lubricants have been more limited than might be desired, such results as have been obtained do confirm, in general, the results shown by the authors.

On the basis of our own work with these materials, we feel a need for additional data regarding certain specific properties of these lubricants. Comprehensive data regarding the viscosity characteristics under varying rates of shear of the various types of polyalkylene glycols,

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[2] Head, Lubrication Branch, Chemistry Division, Naval Research Laboratory. Mem. ASME.

[3] "Some Industrial Experiences With Synthetic Lubricants," by C. H. Sweatt and T. W. Langer, MECHANICAL ENGINEERING, vol. 73, June, 1951, pp. 469–476.

[4] Research Laboratories, Aluminum Company of America, New Kensington, Pa.

and of their derivatives would be desirable. We have noted that the performance characteristics of lubricants are often dependent in a large degree upon the viscosity characteristics of these lubricants under conditions where hydrodynamic effects are involved. Thus, for example, we have noted and confirmed the authors' observations relative to the intrinsically high extreme-pressure characteristics of the Ucon fluids in the absence of any added extreme-pressure agents. However, under certain operating conditions, the Ucon materials have failed to show the promise which would have been expected on the basis of their extreme-pressure characteristics as measured by well-known bench-type apparatus and as later confirmed in the case of mineral oils by field performance. These observations may be due in part to fundamental differences in viscosity pressure and viscosity versus rate-of-shear characteristics. We would be particularly interested in any data relating molecular-weight values of a given Ucon fraction with absolute viscosity values, and with the dependence, if any, of viscosity upon rate of shear as might be measured in a concentric-cylinder-type viscometer or similar apparatus.

Changes of viscosity with pressure of typical Ucon fluids as related to typical mineral-oil lubricants would also be of considerable practical significance. The foregoing comments would also be applicable to mixtures or solutions of Ucon materials in typical mineral oils.

An amplified discussion of the interesting characteristics of the water-soluble 50-HB and 75-H series also would be pertinent. Any information with reference to possible means of reclaiming such materials from water solutions would be most practical.

We agree with the authors that applications for these types of lubricants will be found on a continually expanding basis. Any decrease in initial unit costs also would not be objectionable to this end, for while the over-all costs might be greatly diminished, it is still much more difficult to sell on an over-all cost basis than upon an initial cost basis.

COMMENT BY J. L. PARSONS[5]

As a representative of a concern which uses polyalkylene glycol in high-temperature service, the writer appreciates the information supplied in this paper. The writer's only direct criticism concerns the omission of data that would be equally useful. As a user of these materials, there would seem to be no reason to shy away from the matter of limitations or maximum conditions just because one happens to be the marketer of a new product. Misapplication will do more to give a new product a bad reputation than any other single selling fault.

We are interested in the weakness of new materials as well as in their strength. Records of failure are a yardstick to use in determining the most promising applications. Specifically, data on the solubility and stability of these materials with the usual chemicals of the chemical industry, stability at various temperatures in terms of decomposition rate, and rust-preventive characteristics in terms of humidity-cabinet tests would be of great value.

In addition to this information, compatibility and response of polyalkylene glycols with extreme pressure and other type additives would be useful.

The writer's curiosity was aroused by the kiln-car example where reduced friction and maintenance were obtained through the use of LB-500-X and graphite. What would be the comparable experience in this instance using any one of several commercially available products containing graphite and a vaporizable carrier? In other words, does LB-500-X provide an improvement over other materials designed for kiln-car service?

Again, in the example on gear lubrication, we have found lead oleate to be a very effective extreme-pressure agent for worm gears where spalling is a problem when using normal compounded stocks. Do the authors have any information which compares LB-1200-X with heavy-duty gear oils such as these?

Soluble oil in the metal-working industry has been under considerable discussion in recent years with new chemical products and improvements in the conventional oil available from many sources. In evaluating these materials, much weight is placed on odor, irritant tendencies, and metallic corrosion—the latter being either direct or through lack of protective qualities. More specific information on the 50-HB fluid in this application would be appreciated.

The use of polyalkylene glycols in grease is of special interest as it combines properties to provide new materials with new and untried characteristics. Other than a curiosity and desire for more information, the writer has one question concerning grease SLB-400-A-10, using fine silica as a thickening agent. What happens in high-temperature applications when the polyalkylene glycol vaporizes and leaves the silica behind? Is the residue abrasive? Does it form a powder which blows off or does it agglomerate to form larger particles, and what are the resultant lubrication problems?

COMMENT BY A. C. STUTSON[6]

The material presented in this paper on operation of lubricants in hydraulic-system vane-type pumps does not meet with our experience. The authors presented performance data on petroleum as well as synthetic hydraulic fluids which they developed in comparative vane-pump tests. These data indicated a wear loss of pump parts of 0.91 for a "widely used petroleum hydraulic oil." From the illustrations used, it appears that this loss indicated a total wear of the cam ring and vanes of a well-known hydraulic pump. The test was run for 750 hr at 100 psi and 150 F. The reported test results also show a viscosity increase of 2.2 per cent for the petroleum hydraulic fluid.

For a period of over 10 years we have conducted tests on a great many varieties of petroleum and synthetic hydraulic fluids in a similar test setup, using the same make and design of pump, but operating the test for 1000 hr at 100 psi and 175 F fluid temperature.

The test results so secured indicate an average total wear loss for the vanes and cam ring of 0.0645 gram for seven of the best-known premium-grade oxidation- and rust-inhibited petroleum hydraulic oils offered by various major oil companies today. For the same seven products, the average viscosity increase for this longer and more severe test is 0.71 per cent with a maximum of 1.2 per cent.

A further comparison involving a well-known and widely distributed additive-type hydraulic oil shows a total wear loss of cam and vanes of 3.16 grams. The results with premium-grade straight-mineral oils would fall somewhere between the two figures.

It is evident from these figures that a general comparison cannot be drawn since the results will vary widely with different products. In order to arrive at a specific conclusion it would be necessary to have further details concerning the particular petroleum hydraulic-oil test.

In regard to the illustrations showing pitting of gears, we believe that it is not entirely a matter of oil, but other factors may be quite a bit more important. In fact, tests of two gears in the same gear case, running against the same worm, at the same load and speed, with the same oil, showed differences in

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[6] Technical Division, Industrial Lubricating Department, Socony-Vacuum Oil Company, Inc., New York, N. Y.

pitting due to difference in metallurgical structure of the two bronze gears. The gears were of the same bronze formula, but of different crystal structure owing to casting procedures. Before reaching conclusions based upon the appearance of gear surface, we would give some consideration to bronze structure, inasmuch as pitting is a form of metallurgical fatigue wherein the metal is far more likely than the oil to be responsible for the failure.

AUTHORS' CLOSURE

The authors sincerely appreciate the thought-stimulating ideas and discussion provided by the commentators. So far as current information permits, an attempt will be made to clarify the questions raised.

Messrs. Brophy and Zisman mention the high VI and low pour points of the DLB fluids. Although possessing attractive physical properties, the DLB fluids are considerably more expensive than the LB and HB lubricants and have not been available sufficiently long to accumulate enough industrial experience to include in the paper. The wear-preventive quality of the polyglycols appears to be an inherent characteristic since the fluids with or without the antioxidant additive give substantially the same results on the SAE and other bench-type test machines. In modified SAE wear tests on polyglycols the test cups develop a distinctive blue surface coloration, which suggests oxide formation. The technical literature contains several references to the antiwear action of certain metallic oxides.

In the authors' opinion the antiwear action of the LB and 50-HB fluids is due basically to the difference in chemical structure between polyglycols and hydrocarbons and is exhibited only when operating conditions are such as to permit suitable chemical reactions with the metallic surfaces. Any oxidation products remaining in the lubricant are not essential on the basis of this hypothesis.

Many additives have such markedly different solubilities in polyglycols and mineral oils that direct comparisons are often impossible. When additives are soluble in both types of lubricants the effects are usually similar, but with some antioxidants and other additives surprising differences in performance have been observed. In the vane pump tests viscosity differences are not regarded as a significant factor in the results cited because both the petroleum oil and LB fluid had about the same viscosity, slightly over 300 SUS at 100 F. The question of stability is determined to a large extent by the prevailing conditions. Thus the polyglycols are regarded as more stable than petroleum within certain regions, although they may be less stable in another temperature range, or under different conditions.

In many practical applications, polyglycols have remained substantially unchanged after long-time service in exactly the same system where petroleum oils exhibited sludge formation and other deterioration in a comparatively short time. Nevertheless, it is recognized that once pyrolysis and oxidation starts above approximately 550 F, the polyglycols can decompose rather rapidly. Messrs. Brophy and Zisman correctly point out the desirability of continued fundamental research on the oxidation process, mechanism of lubrication, and general performance characteristics.

In reply to Dr. Kipp's inquiry on the effect of rate of shear on viscosity, indications are that the viscosities of the polyglycols under consideration are practically independent of the rate of shear and that these products are substantially Newtonian fluids over a wide range. At extremely high pressures many oils are known to behave as solids; however, some polyglycol derivatives have been found to continue to act as liquids at pressures of the order of 100,000 psi. Accordingly, it is believed that the antiwear and extreme-pressure properties of the polyglycols can best be ascribed to chemical reactions with the metallic surfaces, as mentioned above, rather than viscosity change with pressure or shear. The water-soluble 50-HB and 75-H series are indeed interesting in that they are completely soluble in water at room temperature, but tend to separate on heating. At approximately 210 F the 50-HB fluids are soluble only to the extent of 40 to 50 ppm. Dr. Kipp's comment on the objection to apparent cost per gallon or pound has been encountered very frequently even when a definite over-all savings is possible in spite of a higher initial lubricant investment.

Naturally there are limitations to the use of polyalkylene glycols as suggested by Mr. Parsons. These often depend on complex relationships involving many factors such as time, temperature, load, speed, aeration, metals present, and the like.

It would be extremely difficult to discuss adequately current limitations in any reasonable period of time, but it seems that corrosion is the most frequent and serious trouble encountered. Nevertheless, it is noteworthy to mention that additives often provide a good solution to this problem. Indeed, considerable quantities of polyglycols are used for certain protective coatings. Further work on different polyglycol-type lubricants and additives will certainly extend their applicability. Of course it should also be realized that the polyglycols would now be used in many more mechanisms except for price considerations. The history of synthetic organic chemicals indicates a downward price trend as production increases and costs are lowered.

Comparative information on the use of a volatile carrier for graphite in kiln-car lubrication is not on hand, but undoubtedly some of the people now using polyglycols have tried such expedients. Similarly, where polyglycols are now being used in gears and metal working, many different products, including some lead soap gear lubricants, were tested previously. In metal-working applications to date, the 50-HB fluids have proved free from objectionable odor and irritant tendencies. Inhibitors are frequently needed to control corrosion, the choice depending upon the metals being worked and other requirements.

With regard to the residues from the SLB-400-A-10 grease, this product has been heated drastically in laboratory tests and yielded a white, bulky powder, very similar in appearance to the original fine-particle silica used as a thickening agent and which would easily blow away. But large hard particles can also be obtained. In any case, SLB-400-A-10 is not recommended for prolonged use in antifriction bearings above approximately 300 F. The most successful applications involve surfaces which are quite hot for short periods and where run-off is to be avoided. Generalizations, however, are notoriously subject to exceptions and in most actual lubrication problems it is advisable to discuss any particular application with the special technical representatives who are available and to establish suitability by careful observation in initial tests.

Mr. Stutson's observation that metallurgical fatigue may cause failure of gears is recognized but there can be no sound objection to any lubricant's ability to compensate for structural or other deficiencies. The significant fact is that in some gear mechanisms polyglycols have provided satisfactory lubrication with low wear in the same service where other lubricants repeatedly gave inferior performance.

C. H. SWEATT.[7]
T. W. LANGER.[7]

[7] Carbide and Carbon Chemicals Company, Tonawanda, N. Y.

Water-Pollution Control

COMMENT BY PAUL W. McKEE[8]

Since this paper[9] discusses some of the activities in connection with legislation and regulations of the States of Pennsylvania and West Virginia, it would seem in order to summarize the Maryland approach to the water-pollution problem.

The Maryland water-pollution control law was passed by the General Assembly of Maryland in 1947, and created a separate commission with control over all forms of pollution other than the discharges which affect the public health. All waste discharges which do affect the public health, whether they arise from industries or municipalities, are subject to the jurisdiction and control of the State Department of Health.

In the water-pollution control law of 1947, pollution is defined as "the discharge or deposit into any of the waters of the State of any liquid or solid substance or substances which may create a nuisance therein or render such waters unclean or noxious so as to be detrimental to the propagation, cultivation or conservation of animals, fish or aquatic life, or unsuitable with reasonable treatment, for use as present or possible future source of public water supply or unsuitable for commercial, industrial, agricultural, recreational or other reasonable uses." This definition of pollution is generally similar to that found in other state legislation with the exception of the effect on public health.

It is the policy of the Maryland Water Pollution Control Commission to prevent pollution of unpolluted waters, although the law does not provide for a permit system and contains no other preventative measures.

Under the Maryland law, a pollution condition must exist before action may be taken to correct this condition. The commission has legal authority to control and abate existing pollution where such discharges are in violation of any specific rule, regulation, or order of the commission.

In Maryland, the Water Pollution Control Commission is a policy-making board composed of three members appointed by the governor, and four ex-officio members representing various state agencies interested in maintaining clean streams throughout the state.

In enforcing their policy, the Maryland commission has passed four specific regulations.

Regulation I makes it unlawful to discharge oil in any manner into or upon the waters of the state. This regulation has now been superseded by an act of the General Assembly of Maryland of 1949, which added new sections to the Water Pollution Control Law, specifically for the control of oil discharges from vessels in Maryland waters. This additional section also increased the penalty for oil discharges to a maximum of $2500 nor less than $500.

Regulation II makes it unlawful to deposit, throw, or discharge garbage into or upon any of the waters of the state.

Regulation III was directed specifically at the food-processing and food-packing industry in Maryland. It restricts the particle size of solids discharged as a minimum that must be complied with by all the food-packing industry and adds as a secondary requirement the treatment of strong dissolved organic waste, caustic, acid, lye, and other deleterious substances wherever such are discharged.

Regulation IV was written as an effluent standard which requires all industries in the state discharging wastes to state waters to meet nine waste-effluent requirements before discharging into any of the waters of the state. These nine effluent requirements of Regulation IV are as follows:

1 Solids:

(*a*) Solids in the effluent must not exceed $^1/_{32}$ in. particle size.

(*b*) Total suspended solids must not exceed 400 ppm.

(*c*) Dissolved solids must not exceed 1500 ppm.

(*d*) Total solids must not exceed 1900 ppm.

2 Turbidity: Must transmit 10 per cent of light through 12 in. of sample in a 3-in. column, or not to exceed 300 ppm, as determined by the Jackson candle turbidimeter.

3 Oxygen consumption must not exceed 50 per cent of normal saturation of dissolved oxygen in the receiving stream.

(*a*) Biochemical oxygen demand in effluent must not exceed 100 ppm.

4 Toxicity or toxic compounds—eliminate, or reduce to limits of tolerance, substances toxic to human, livestock, fish, aquatic, and wildlife.

5 Color intensity regardless of light frequency must not exceed 400 ppm on the chloroplatinate scale.

6 pH must not range below 5.5 or above 8.5.

7 Temperature must be below 100 F in the stream within 50 ft from waste outlet.

8 Oils and grease must not exceed 30 ppm.

9 Taste and odor: Effluent must not exceed threshold odor number of 1000. Mixture of the waste and receiving waters shall have a threshold odor number not in excess of 80.

Other than the four regulations, the commission also has established criteria for the classification of Maryland streams. These criteria are identical with those established by the West Virginia Water Commission as presented in Table 2 of the paper. However, Maryland does not use these criteria as a control measure but simply as a method of designating stream conditions throughout the state.

Maryland and its Pollution Control Commission take an active part in interstate pollution affairs in the Potomac River Basin, and members of its commission and staff are also members of the Interstate Commission on the Potomac River Basin, which includes the Potomac River Drainage area in Pennsylvania, West Virginia, Virginia, the District of Columbia, and Maryland.

The present pollution-control legislation and program in Maryland is a considerable improvement over what it was prior to 1947. Before this commission was created, pollution-control activities were divided between four state agencies, namely, the State Department of Health, the Department of Tidewater Fisheries, the Department of Game and Inland Fish, and the Department of Research and Education.

Considerable improvement of the present control of water pollution in Maryland should be made since there is some overlapping of jurisdiction and authority by the two agencies now involved—the State Department of Health and the Water Pollution Control Commission.

AUTHORS' CLOSURE

The above comment is an excellent contribution to the study of water-pollution control legislation today, since it presents completely and concisely the approach of one typical state to the problem. The comment also brings out the advantages of incorporating water-pollution control activities into one body and the difficulties that often arise in completing that essential unification of function.

M. D. WEISS.[10]

[8] Executive Secretary, Water Pollution Control Commission of the State of Maryland, Baltimore, Md.

[9] "Water Pollution by Industry," by D. F. Othmer, M. D. Weiss, and R. S. Aries, MECHANICAL ENGINEERING, vol. 73, September, 1951, pp. 706–708.

[10] Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Older Engineers Should Be Employed to Relieve Shortages

TO THE EDITOR:

A shortage of engineers and scientists is plaguing industry. Not long ago, however, executives were known to say that such men were a dime a dozen. A hangover from such an attitude is one of the reasons for the difficulty now experienced in finding such men. Here are some suggestions for overcoming at least in part this problem in human relations:

1 Every written application for a job should be acknowledged. A letter is not necessary; a long-hand note across the face of the application with some comment as to the reason for its rejection is all that is necessary. The application if desired can be returned in a plain envelope. The man who made the application spent some time in writing it; the recipient should be courteous enough to acknowledge it. The cost of acknowledgement is negligible.

Where this policy has been pursued, letters and telephone calls of thanks are not unusual. Obvious suggestions for improving a letter of application if the emphasis is wrong or it is poorly spelled or typed are not out of order.

2 Avoid emphasis on youthful ages if the older man could possibly be used. Only rarely is an advertisement seen with the phrase, "No age limit." There are many men over sixty who are worth while as employees. If such ages conflict with the requirements of the group-life insurance or pension policy, the new employee could be asked to waive inclusion under it.

3 Organize work to fit the personalities and the abilities of applicants; do not try to fit them to a preconceived chart of organization. Older men often have special experience and training that can be used if the employer is resourceful.

4 Cater to the feelings of the older man by arranging his work so he does not have to knuckle to some younger man with less experience. The older man's earning power may have dropped with age but his keenness of judgment is still there. He is a human being who may object to a subordinate position after years of responsibility. The employer should build up his confidence and not knock it down through lack of consideration.

5 Emphasis on a long work-week as a means to increased earnings through overtime is not an inducement to the older man. His strength may not permit him to work under pressure for long hours. Arrange his work so he does not have to put in more than the usual hours of 35 to 40 weekly. Let the younger men take the overtime and pressure.

6 Allow for traveling time if an employee has to come from some distance by train or automobile, in setting up the work-week, particularly with older men.

7 Maintenance expenses away from home are not offered frequently enough. The older man, however, probably has a home he cannot sell or lease or for obvious reasons does not wish to sell or lease for what may be a short-term job. Certainly an offer of such expenses should be made during a trial period until the employer and the applicant can determine that they want to work together for a long period.

8 Moving expenses are frequently offered to men sought for out-of-town jobs but they should be sufficiently adequate.

9 Some employers are running training classes for their new employees. More should do so. The older men have sometimes forgotten much of the theory needed for design or laboratory. A chance to brush up on what they learned years ago will develop valuable employees who will use their experience to temper inadequate theories.

10 The new employee should be encouraged to make suggestions for better methods. In so doing, the confidence particularly of the older employees is increased. They probably have done work in a different way in some other organization similar to what they are being asked to do. The new and older employee often proves to be an excellent investment.

11 Subdivide and subdivide again the work to be done until it can be done by the applicants obtained. The more experienced and better-trained men should be used to set up standards within which less experienced and more poorly trained men can work. This approach has been used by industrial engineers for years as the way to low manufacturing costs. It is still a valuable tool even in executive, design, and laboratory departments.

12 Advertising a job that does not exist merely as a way of building up a list of applicants for a possible future job is reprehensible in any employer or employment agency. The job often does not develop.

13 A man's references should not be checked until he has consented. An apparent black spot in his record may be nothing more than clashing personalities or the selfish interests of a former employer. Scrupulously keeping faith with an applicant is a minimum requirement.

Some engineers in executive capacities have not been too careful in the past of the welfare of engineering subordinates—hence the engineering labor unions that have developed.

A shortage of engineers and scientists? Sure! But as engineers let's use the best methods in human relations and management to meet it!

GREGORY M. DEXTER.[11]

Mercury-Steam Power Plants

COMMENT BY J. H. SAMS[12]

This paper[13] gives useful information on current operating results and encourages further study of the mercury-steam power plant for power purposes. The use of new type mercury-vapor generators shows encouraging progress and will eliminate many of the difficulties encountered with the earlier types.

The thermodynamic advantage of the mercury steam cycle has always been attractive and has kept it alive for consideration not only as a topping plant but also in the design of new plants. The renewed interest in the reheat cycle has improved over-all thermal efficiencies obtained from the straight regenerative cycle and has again narrowed the gap between the steam and the binary-vapor cycles. However, the chart given in the paper shows that there is still an appreciable difference in the heat rate between the reheat-regenerative cycle and the binary vapor cycle. While this shows only about 1100 Btu difference in the high-capacity field, this difference becomes over 2400 for the smaller plants and makes a thorough investigation of the mercury plant worth while.

Either type of plant must stand on its own feet from an economical standpoint, and the higher first cost of the binary-vapor system must be offset by the lower operating cost. It will be interesting to observe the results of the new binary-vapor plant in New Hampshire in order to compare the annual cost for this plant against well-designed steam plants of about the same capacity.

[11] Consulting Engineer, Scarsdale, N. Y. Mem. ASME.

[12] Dean, School of Engineering, Clemson College, Clemson, S. C. Mem. ASME.

[13] "Mercury-Steam Power Plants," by H. N. Hackett, MECHANICAL ENGINEERING, vol. 73, July, 1951, pp. 559–564.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Incentive Management

INCENTIVE MANAGEMENT. By James F. Lincoln. The Lincoln Electric Company, Cleveland, Ohio, 1951. Cloth, 5¾ × 9 in., appendix, 11 charts, 280 pp., $1.

REVIEWED BY PHIL CARROLL[1]

THE author argues strenuously that we must put incentive back into our American way. He emphasizes that we are strangling ourselves by trading freedom for security. He decries our method of progressively penalizing the more industrious, risk-taking leaders, who can create and expand opportunity.

He pleads for industrial leadership that will unlock the latent potentials in men. Recently Paul Hoffman said about the same thing. "Our society is organized to promote conditions which challenge the individual to realize his capacities." Again, in 'Human Destiny," du Nouy says the desire to attain a superior level is "the trait which above all others links man most clearly to the divine task of evolution." Lincoln's words are "the point that we usually miss is that millions of incipient leaders, some of whom would have been even greater than those we know, have gone to their graves as unknowns because they did not, or would not, face crises which would develop the latent abilities which would have made them leaders."

Lincoln's "incentive management . . . is a means of giving the opportunity and spur to the individual so that he will develop these abilities of his, now latent. It is obvious that the Creator in giving to man such abilities expected them to be used."

Lincoln's incentive management is a philosophy—not a method. He stresses the difference with many examples in amateur athletics. He says it "is not a method of merely paying more for more production—it is not a new method of wage payment." "It is instead a new conception of the relationship of so-called management and employees." His unprecedented employee earnings are result, not cause.

He insists that teamwork of the whole organization can lift industry to several times our present productivity. He has proved that jobs and earnings multiply with cost and price reduction. And he shows that his factory employees have averaged 15.35 per cent increase in productivity per year since 1934 as compared with 2.74 per cent for the machinery industry.

He uses four ways to reward each individual for his contributions: Piecework prices set by time study pay directly for production; merit rating quarterly is used to reward, advance, and transfer people as they develop; suggestion awards, not mentioned, liberally compensate those who contribute cost-reducing ideas. Profits generally distributed doubly emphasize these three incentives by proration on earnings. And finally, employee stock ownership values are increased by capital gains plowed back.

The comparative tables in the appendix show Lincoln employee earnings to be nearly double those in other companies cited. At the same time, the "employment costs" as a per cent of net sales appear to be about half.

This book could be profitably read by all management, union, and government leaders. And I think we would do well to have our foremen study it.

[1] Consulting Industrial Engineer, Maplewood, N. J. Fellow ASME.

Corrosion Guide

CORROSION GUIDE. By Erich Rabald. Elsevier Publishing Company, Inc., New York, N. Y.; Amsterdam, The Netherlands; London, England; Brussels, Belgium, 1951. Cloth, 6 × 9½ in., figs., tables, bibliography, index, vi and 629 pp., $12.50.

REVIEWED BY C. H. FELLOWS[2]

THIS book ably condenses the latest corrosion information on a large variety of engineering materials used in process work. German and British sources appear to have been reviewed principally by the author but this should not be considered to be a detraction.

The text, comprising about 50 of some 600 pages, does not appear to present new material, but is a brief and understandable condensation of the theory of corrosion as published by recognized investigators.

There seems to be no question as to correctness of the data. This statement is not based on an exhaustive check of the tabular data but on a sufficient check to justify the remark. In the interest of completeness, the information given for water might have been expanded to include several nonferrous alloys of nickel and copper at several temperatures and concentrations of dissolved gases.

This reviewer likes the tabular presentation. For the person seeking more fundamental information, it would seem that some correlation between the tabulated material and the bibliography would be helpful. This is a question of opinion.

In general, the book should be useful to engineers concerned with the selection of material used in process engineering. Perhaps unfortunately for the American engineer, he is required to think in terms of the centigrade scale of temperature measurement.

The author should be enthusiastically commended for this work.

[2] Director of Engineering Laboratory and Research Department, The Detroit Edison Company, Detroit, Mich.

Books Received in Library

AIRCRAFT MATERIALS AND PROCESSES. (Pitman Aeronautical Engineering Series.) By G. F. Titterton. Fourth edition. Pitman Publishing Corp., New York, N. Y.; Toronto, Canada; London, England, 1951. Cloth, 6 × 9¼ in., 359 pp., illus., diagrams, charts, tables, $5. Essential information on materials and processes used in the construction of aircraft is described from a utilitarian point of view. Materials covered are steel and steel alloys, nonferrous alloys, wood and glue, fabrics and dope, plastics, natural and synthetic rubbers. Important processes covered are materials testing, heat-treatment, surface hardening, metal-forming aluminum alloy casting, metal joining, and corrosion and its prevention. The data are mainly from government sources and the Society of Automotive Engineers' Handbook.

BUSINESS AND PROFESSIONAL SPEECH. By L. Crocker. Ronald Press Co., New York, N. Y., 1951. Cloth, 5½ × 8¼ in., 463 pp., charts, tables, $4. A detailed treatment of the basic

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

aspects of speaking before an audience or group, covering grammar, selection of material, presentation of ideas, and so on. Part 2 presents examples of common types of business and professional speeches. Appended are a bibliography and a section on suggestions to teachers.

COMBUSTION, FLAMES, AND EXPLOSIONS OF GASES. By Bernard Lewis and Guenther von Elbe. Academic Press, Inc., New York, N. Y., 1951. Cloth, $6^1/_2 \times 9^1/_2$ in., 795 pp., charts, tables, illustrations, $13.50. Part 1 of this extensive treatise deals with the chemistry and kinetics of the reactions between oxygen and the following fuel gases: hydrogen, carbon monoxide, and various hydrocarbons. Part 2 comprising about one half of the text, provides an exhaustive treatment of flame propagation, covering combustion and detonation waves, ignition, fuel-jet combustion, and flame photography. Part 3 examines the state of the burned gas, and Part 4 discusses the relation of the foregoing to a variety of technical combustion processes such as industrial heating and internal-combustion engines.

CORROSION GUIDE. By E. Rabald. Elsevier Publishing Co., New York, N. Y.; Amsterdam, The Netherlands; London, England; Brussels, Belgium, 1951. Cloth, $6^1/_2 \times 10$ in., 629 pp., illus., diagrams, charts, tables, $12.50. The major part of this practical reference work is composed of tables showing the interaction phenomena between more than 40 important construction materials (metallic and nonmetallic) and some 250 corrosive agents. The object is to provide the chemist or engineer with readily usable information in the choice of materials for laboratory or industrial processes. Corrosion fundamentals are discussed in an introductory section, and a table of the physical properties of the materials involved is provided. A bibliography lists important books and periodicals.

CUTTING-TOOL MATERIALS. By Eric N. Simmons. Sir Isaac Pitman and Sons, Ltd., London, England, 1951. Cloth, $5^1/_2 \times 8^3/_4$ in., 188 pp., tables, figs., 21s. A comprehensive treatment of the various types of steels and alloys used in cutting tools from ordinary knives to machine tools, describing their applications, heat-treatment, and composition. Chapters are included on high-speed and carbon-tool steels, stellite, tungsten-carbide and similar alloys, butt-welded and atomic-hydrogen-welded tools, grinding cutting-tool materials, and testing and inspection of tool steels. An appendix lists tool types alphabetically with the corresponding recommended type of steel.

DAVISON'S TEXTILE BLUE BOOK, 86th Year, July, 1951. Davison Publishing Co., Ridgewood, N. J. Fabrikoid, $5 \times 8^1/_4$ in., 1475 pp., illus., diagrams, tables, office edition (with Classified Directory & Buyer's Guide), $9.25; handy edition (without Classified Directory & Buyer's Guide), $6.50. A complete directory of textile mills and products. The information in this volume is arranged geographically under product, raw materials, dealers, and manufacturers. There are alphabetical indexes giving name of proprietor and mills of all textile manufacturers, dyers, finishers, and so on, in the United States and Canada.

GAS TURBINE THEORY. By H. Cohen and G. F. C. Rogers. Longmans, Green and Co., London, England; New York, N. Y.; Toronto, Canada; 1951. Cloth, $5^3/_4 \times 8^3/_4$ in., 291 pp., charts, diagram, $5.75. After an introductory chapter on the adaptability of the gas turbine, a comprehensive study of the performance of various cycles is developed, a chapter on gas dynamics introduces the reader to the relevant phenomena associated with high-speed flow and this is followed by an account of the methods of estimating the design-point performance of shaft-power gas turbines and turbojet engines. The work continues with chapters on the theory of centrifugal and axial compressors, combustion systems and turbines, and closes with an estimation of gas-turbine performance over the whole operating range.

HELICOPTER ANALYSIS. By Alexander A. Nikolsky. John Wiley & Sons, Inc., New York, N. Y., 1951. Cloth, $6 \times 9^1/_4$ in., 340 pp., charts, tables, $7.50. A general physical picture is given of helicopter theory, and a possible approach is provided to the analysis of some basic helicopter problems. Topics covered include the following: the helicopter in steady vertical flight; hinges, flapping, and feathering systems; forward flight; and the elastic analysis of rotor blades. Particularly important are the three chapters covering dynamic stability and control, a considerable part of which represents the author's original analysis.

INDUSTRIAL FURNACES, volume 1. By W. Trinks. Fourth edition. John Wiley & Sons, Inc., New York, N. Y., 1951. Linen, $6 \times 9^1/_4$ in., 526 pp., illus., diagrams, charts, tables, $10. The fourth edition of volume 1 of this important treatise has again been thoroughly revised, some forty per cent of the book having been entirely rewritten. The work is a comprehensive exposition of the principles which underlie furnace operations and the design of furnaces for heating and annealing metals. The capacity, fuel economy, strength, and durability of furnaces and the movement of gases in them are discussed theoretically and practically. Heat-saving appliances are dealt with in detail with particular reference to industrial furnaces.

INDUSTRIAL WASTES. By C. H. Lipsett. Atlas Publishing Co., New York, N. Y., 1951. Cloth, $6 \times 9^1/_4$ in., 317 pp., tables, $5. A comprehensive survey of the field of important industrial wastes including their economic function and utilization in the industrial field. The discussion covers origins, collection methods, marketing procedures, recovery processes, and so on. The wide range of subject matter includes plastics, chemicals, metals, textiles, rubber, paper, leather, wood, glass, and organic and agricultural wastes.

MAKING, SHAPING, AND TREATING OF STEEL. A complete revision based on the original text by J. M. Camp and C. B. Francis. Sixth edition, 1951. Cloth, $6^1/_4 \times 9^1/_4$ in., 1584 pp., diagrams, tables, $7.50, apply to treasurer, United States Steel Co., 525 William Penn Place, Pittsburgh, Pa. Thoroughly revised, and in large part rewritten, this standard reference work is now the result of the cooperative efforts of a large group of the technical and research personnel of the United States Steel Company. The information contained is a compilation of past and present practices in the iron and steel industry as summarized by numerous specialists and as based on their practical experience. In addition to the extensive coverage of the processes named in the title, the work covers fundamental chemical and physical principles, refractories and fuels, fluxes and slags, cast iron, sponge and wrought iron, special steels, and mechanical testing methods. The detailed 150-page index provides rapid reference to the contents.

MANUFACTURING EQUIPMENT AND PROCESSES. By C. W. Lytle and A. F. Gould. Third edition. International Textbook Co., Scranton, Pa., 1951. Cloth, $6 \times 9^1/_4$ in., 759 pp., illus., diagrams, charts, tables, $6.50. A useful survey of good modern machine tools and fundamental manufacturing processes, intended for the engineer who needs to know production machinery with a view to its selection or application for economic production. With this purpose in mind, essential operating principles are stressed, limitations in application are pointed out, and economic considerations are discussed. The detailed descriptions of machine types are illustrated by photographs, and explanatory drawings are used as needed.

MATERIALS BUYING MANUAL. By H. A. Knight. Conover-Mast Publications, New York, N. Y., and Chicago, Ill., 1951. Linen, $6 \times 8^3/_4$ in., 340 pp., charts, tables, $4.50. Basic facts are given concerning a wide range of commodities used in industry covering general description, properties, production methods, commercial grades, and uses. The relation of the particular commodity to the general scheme of the industry using it is indicated. Written primarily for industrial purchasing agents, the book is also useful as a general reference work. Listings are alphabetical by major items and topics.

MATHEMATICS FOR ENGINEERS. By R. W. Dull. Revised and edited by R. Dull. Third edition. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1951. Cloth, $5^1/_2 \times 8^1/_4$ in., 822 pp., diagrams, charts, tables, $7.50. Beginning with algebra and continuing through logarithms, determinants, the slide rule, trigonometric functions, the calculus, and dimensional and similarity analysis, this work affords a convenient review of those phases of mathematics which are especially important in engineering work. It is intended either for use as a practical reference work or as a text for private study. A chapter on differential equations has been added, and other revisions have been made to bring the book up to date.

MODERN PLASTICS ENCYCLOPEDIA AND ENGINEER'S HANDBOOK, 1951. Plastics Catalogue Corporation, New York, N. Y. Paper, $8^1/_2 \times 11^1/_4$ in., 636 pp., illus., diagrams, charts, tables, $2. The new edition of this useful reference work differs considerably from the previous ones. The information which has become standardized is now omitted as it is available in the previous editions. This edition tells in detail what is new during the past year in plastics materials, applications, machinery, engineering, and techniques. The directory section contains not only buyers' guides for materials, equipment, and so on, but also lists of trade associations, schools with courses on plastics, motion-picture films on plastics, and trade names.

WOOD TECHNOLOGY, Constitution, Properties and Uses. By H. D. Tiemann. Third edition. Pitman Publishing Corporation, New York, N. Y.; Toronto, Canada; London, England, 1951. Linen, 6 × 9¼ in., 396 pp., illus., diagrams, charts, tables, $6. The beginning chapters of this comprehensive work discuss the structure of wood and present a method for identifying different kinds of wood by visible structure. The chemistry of wood and cellulose precedes information on the making of pulp and paper from wood. Moisture relations and the problems of shrinkage and swelling are dealt with, followed by drying and gluing practices. Mechanical and physical properties under varying conditions are evaluated. Biological destructive agencies and their prevention are briefly discussed.

THEORY OF ELASTICITY. By S. Timoshenko and J. N. Goodier. Second edition. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1951. Linen, 6 × 9¼ in., 506 pp., illus., diagrams, charts, tables, $9.50. The theory of elasticity must be used where the elementary theory of strength of materials proves insufficient, as in dealing with local stresses near loads and supports and in regions of sharp variation of cross section. This book presents the fundamentals of that theory with special reference to the needs of the engineer. The presentation considers both two and three-dimensional problems. Photoelastic, soap-film, and other experimental methods are included. The additions and revision of the current edition express the developments in the field during the seventeen years since the previous edition was published.

ASME BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting November 2, 1951, and approved by the Board, January 9, 1952.)

CASE NO. 1056–4 (REOPENED)

(Special Ruling)

Add as a second paragraph to the "Reply":

This material is classified in Section IX in Table Q-5, as P-3, O-1.

CASE NO. 1116–1 (REOPENED)

(Special Ruling)

Revise latter half of Par. 4 of the "Reply" to read:

. . . the design stress may be taken as one fifth the specified minimum tensile strength for Tables U-2 and U-4 of Section VIII, 1949, and the design stress may be taken as one fourth the specified minimum tensile strength for Tables P-5 or P-7 of Section I and for Table UG-23 of Section VIII, 1950.

CASE NO. 1119–1 (REOPENED)

(Special Ruling)

Inquiry: May austenitic chromium-nickel alloy steels which are stabilized with columbium plus tantalum be used under Code rules which are applicable to the use of stainless steel Types 309Cb, 316Cb, and 347?

Reply: It is the opinion of the Committee that austenitic chromium-nickel alloy steels which are stabilized with columbium plus tantalum instead of columbium only may be used under the Code rules which are applicable to the use of Types 309Cb, 316Cb, and 347, with the following restrictions:

1. Material—The material shall conform to an approved specification and grade covering Types 309, 316, or 347 modified by additions of columbium, except that the requirements for columbium contents shall be modified as follows:

Columbium—determination not required.
Columbium plus tantalum—1.25 per cent max; 8 × the carbon content min.

NOTE: This minimum Cb + Ta content is in accordance with NPA regulations and shall revert to the standard limits given in the applicable specifications upon cancellation of the NPA limitations.

2. Until such time as the NPA regulations are canceled, these steels, stabilized with columbium alone, may be used with a minimum columbium content of 8 × the carbon content.

3. Working stresses shall be the same as those listed for the standard grades stabilized with columbium alone.

CASE NO. 1146

(Special Ruling)

Inquiry: Pending issuance of emergency alternate specifications by ASTM to reflect the conservation of critical alloying material, may the molybdenum content of Code specifications be lowered by 0.05 per cent?

Reply: It is the opinion of the Committee that the intent of the Code will be met if the upper and lower limits of molybdenum content are reduced by 0.05 per cent. The allowable stresses assigned to the grade in question need not be reduced.

CASE NO. 1147

(Special Ruling)

Inquiry: Since nickel is in short supply, may 90–10 copper-nickel sheets and plates be used in the construction of unfired pressure vessels? If so, what maximum allowable stress values are to be used?

Reply: It is the opinion of the Committee that 90–10 copper-nickel sheets and plates may be used in the construction of unfired pressure vessels provided:

(a) the chemical composition conforms to Specification SB-111;

(b) the mechanical properties are not less than:

Tensile str., min psi	40,000
Yield str., min psi	15,000
Elongation in 2 in., min per cent	30

The maximum allowable stress values shall be as follows, provided the hydrostatic test pressure does not exceed 1½ × the design pressure:

For metal temperature not exceeding deg F				
Up to 150	250	300	350	400
10,000	9,500	9,300	9,000	8,700
450	500	550		600
8,300	7,500	6,700		6,000

CASE NO. 1149

(Special Ruling)

Inquiry: May the revisions to Pars. P-180, P-195, P-198, P-268, P-325, A-30, A-32, and A-125, as published in the November, 1951, issue of MECHANICAL ENGINEERING, be used with the revised allowable stress values for Tables P-5 and P-7, as published in the August, 1951, issue?

Reply: It is the opinion of the Committee that the provisions referred to in the Inquiry may be used in Code construction.

CASE No. 1150

(Special Ruling)

Inquiry: Is it permissible to use the following ASTM emergency alternate provisions affecting existing Code specifications:

EA-167, EA-213, EA-240, EA-249, EA-271.

The changes consist only in a permitted increase of phosphorus content.

Reply: It is the opinion of the Committee that the above listed ASTM emergency alternate provisions in the corresponding Code specifications may be considered as meeting the intent of the Code.

CASE No. 1151

(Interpretation of Par. U-17)

Inquiry: Do the thickness limitations contained in Par. U-17 refer to nonferrous materials?

Reply: It is the opinion of the Committee that the requirements of Par. U-17 pertain to nonferrous materials except that for noncorrosive service in welded construction the minimum thickness may be $^1/_{16}$ in.

Proposed Revisions and Addenda to Boiler Construction Code

AS need arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code. Simple changes are indicated directly. In the more involved revisions added words are printed in SMALL CAPITALS; deleted words are enclosed in brackets [ ].

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Power Boilers 1949

TABLE P-7. Revise footnote (7) to read:

(7) To these stresses, a casting quality factor of 80 per cent shall be applied.

PAR. P-27 Add as a new paragraph:

P-27 Quality Factors for Steel Castings. A quality factor as specified below shall be applied to the allowable stresses for steel casting materials as given in Table P-7.

(a) A factor not to exceed 80 per cent shall be applied when a casting is inspected only in accordance with the minimum requirements of the specification for the material, except when the special methods of examination prescribed by the selected specification are followed, thus permitting the use of the applicable higher factor in this paragraph.

(b) A factor not to exceed 90 per cent shall be applied when a casting is inspected both in accordance with the minimum requirements of the material specification, and as follows:

(1) Each casting shall be subjected to a thorough inspection of all surfaces, particularly such as are exposed by machining or drilling, without revealing any injurious defects. At least three pilot castings representing the first lot of five castings made from a pattern of new or altered design shall be sectioned, or radiographed, at all critical sections without revealing any injurious defects;

(2) One additional casting taken at random from every subsequent lot of five shall be sectioned or radiographed at all critical sections without revealing any injurious defects;

(3) In addition all castings, other than those which have been sectioned or radiographed, shall have critical sections examined, using either the magnetic powder method, fluorescent or colored penetrating oil method, penetrant oil powder method, or grinding and etching.

(c) A factor not to exceed 90 per cent may be used for a single casting which has been radiographed at all critical sections and found free of injurious defects.

(d) A factor not to exceed 90 per cent may be used for a casting which has been machined to the extent that all critical sections are exposed for inspection for the full wall thickness as in drilling tube sheets with holes spaced no farther apart than the wall thickness of the casting. The inspection afforded may be taken in lieu of destructive or radiographic testing required in (b).

(e) Castings complying with ASA B16e-1939 and Supplement No. 1 (ASA B16e6-1949) shall be used within the ratings assigned in the Standard.

(f) In addition, the requirements in Appendix Par. A-130 et. sec. for inspection and marking shall also be met when a casting quality factor exceeding 80 per cent is used.

APPENDIX Add the following as a new appendix—

STEEL CASTINGS INSPECTION AND MARKING REQUIREMENTS FOR HIGHER QUALITY FACTOR

A-130 Definitions. (a) Pilot Castings. A pilot casting shall be defined as any one casting, usually one of the first from a new pattern, poured of the same material and using the identical foundry procedure (risering, gating, pouring and melting) as the castings it is intended to represent. Any pilot casting or castings taken to represent a lot and the castings of that lot shall be poured from a heat of steel from which the castings on the current order are poured.

(b) Critical Sections. The critical sections of a casting are defined as the sections where defects are usually encountered, such as the junction of risers, gates, or feeders to the castings, and at abrupt changes in section.

A-131 Radiographing. Radiographing, where required, shall conform to the "General Specifications for Inspection of Material, Appendix II—Metals, Part F—Radiography, Section F-1, Definitions and Radiographic Requirements, Navy Department, Washington, D. C., March 1, 1942, Preliminary Draft. Radiographic standards shall conform to "Radiographic Standards," July 1, 1942, prepared by the Bureau of Ships, Navy Department.

A-132 Defects. Serious defects shall be the basis for the rejection of the casting and the inspector shall have the right to demand a similar inspection of additional castings from the same heat until acceptable castings are consistently produced where a 90 per cent quality factor is used. Where defects not impairing the strength of the casting have been welded up, the completed repair shall be subject to reinspection, and to obtain a 90 per cent factor, the repaired casting shall be stress-relieved.

A-133 Identification and Marking. Castings to which a quality factor of 90 per cent is to be applied shall be marked with the manufacturer's and materials identification marking and in addition the applicable quality factor shall be clearly stamped on the casting. Mill test reports or certificates furnished by the manufacturer shall certify that the castings conform to the requirements of the Code.

Material Specifications 1949

EDITORIAL NOTE

The Boiler Code Committee has approved the addition to Section II as a new specification SA-336-51T, Specification for Alloy Steel Seamless Drum Forgings. This new specification will be incorporated in the 1952 edition of Material Specifications. Meantime those in need of this may secure copy from ASTM.

EDITORIAL CORRECTION

In Specification SA-106-48T, Specifications for Seamless Carbon Steel Pipe for High-Temperature Service, delete the last sentence in Par. 2(a)—Process.

Low-Pressure Heating Boilers 1949

PAR. H-104(e) Delete third paragraph and substitute:

Capacity certification tests of relief valves for hot-water boilers and tanks shall be conducted at 110 per cent of the pressure for which the valve is set to operate.

Announcement

Welding Qualifications, Section IX, newly revised has been approved by the Boiler Code Committee.

ASME NEWS

With Notes on the Engineering Profession

Applied Mechanics Experts Prepare for Eighth International Congress

To Be Held at Istanbul, Turkey, August 20–28, 1952

SCIENTISTS and engineers working in the field of applied mechanics are looking forward with great expectation to the Eighth International Congress for Applied Mechanics to be held at the University of Istanbul, Istanbul, Turkey, on August 20 to 28, 1952. The Congress combines the opportunity of personal contacts with scientists and engineers of great distinction from many nations, representing the leading centers of research in elasticity and plasticity, fluid mechanics, mechanics of solids, and heat transfer, with a visit to a beautiful historic city in a country of world-wide interest today.

The First International Congress was held in 1924 at Delft, Netherlands, following a preliminary meeting in 1922 at Innesbruck, Austria, organized by Prof. Theodore von Kármán. Except for the war period, meetings have been held at four-year intervals, at Zürich in 1926, Stockholm in 1930, Cambridge, England, in 1934, Cambridge, Mass., in 1938, Paris in 1946, and London in 1948. In most cases, proceedings have been published which constitute valuable reviews of the state of knowledge at the time. The Congress is a voluntary association of individual scientists organized every four years by a local committee named by a continuing International Committee. U. S. members of the International Committee are H. L. Dryden, J. C. Hunsaker, Theodore von Kármán, and S. Timoshenko, The Applied Mechanics Division of The American Society of Mechanical Engineers, since its formation in 1928, has always taken an active part in co-operating with the International Committee. American participation in the Eighth Congress is being organized by the U. S. National Committee on Theoretical and Applied Mechanics, a Joint Committee of ASME, AIChE, SESA, ASCE, IAS, American Mathematical Society, American Physics Society, of which H. L. Dryden is chairman and C. E. Davies, secretary.

Congress Membership

Membership in the Congress is open to all individuals interested in applied mechanics. Each member may present two 15-minute papers. Abstracts not exceeding 400 words in length must be submitted not later than June 1, 1952, on forms which may be secured from the Secretary of the Congress. (Sekizinci Enternasyonal Teorik ve Tatbiki Mekanik Kongresi, P. K. 245, Istanbul, Turkey.) The Congress will meet in five sections as follows: I—Elasticity, Plasticity, Rheology; II—Fluid Mechanics (Aerodynamics, Hydrodynamics); III—Mechanics of Solids (Ballistics, Vibrations, Friction, Lubrication); IV—Statistical Mechanics, Thermodynamics, Heat Transfer; V—Mathematics of Physics and Mechanics—Methods of Computation. The proceedings will be published, including invited addresses and lectures by a few outstanding scientists and engineers.

There will be many interesting social and entertainment features, including receptions by the Rector of the University of Istanbul and by the Governor and Mayor of Istanbul and the official dinner which all members of the Congress are entitled to attend. Visits will be arranged to the Old Seraglio, Museum of Ancient Orient, Museum of Antiquities, famous churches and mosques, such as the mosque of Soliman the Magnificent, the Grand Bazaar, and similar places of interest, as well as a sea excursion up the Bosporus to the entrance of the Black Sea.

Travel

In view of the high demand for travel services in Europe, sea and air transportation will be heavily booked during the summer and autumn of 1952. It is therefore important that prospective Congress members arrange their transportation at their earliest convenience.

The American Express Company, as the official travel agency of the Congress, offers the following tours which in the opinion of the U. S. National Committee meet the needs of most U. S. participants: *Tour A:* For those with very limited time, all travel by air. Leave New York Saturday, August 16, to Rome via TWA, thence to Istanbul via BEA, arriving August 18. Returning from Istanbul on Friday, August 29, arriving in New York Sunday, August 31. Approximate all-expense cost, $1318 or, alternatively, if air coach rates are applicable, $1048. *Tour B:* For those desiring additional sight-seeing in Italy. Leave New York Wednesday, August 6, via S. S. Constitution for Naples, calling at Gibraltar and Cannes. Sightseeing Naples and Rome. Rome to Istanbul via BEA, arriving August 19. Returning from Istanbul on Saturday, August 30, via BEA to Rome, Sightseeing Florence, Venice, Genoa. Sail from Genoa Sunday, September 7, via S. S. Constitution, arriving New York Monday, September 15. Approximate all-expense cost, minimum first class $1355, minimum cabin class $1220, minimum tourist class $1115. *Tour C:* Same as Tour B, except air travel. Leave New York Thursday, August 14, joining Tour B at Naples. Returning, leave Venice Friday, September 5, to Milan, thence to New York, arriving New York Saturday, September 6. Approximate all-expense cost, $1486 or, alternatively, if air coach rates are applicable, $1216.

Other Tours Arranged

Individual tours to meet special requirements may be arranged. For details write to the American Express Company, 624 Fourteenth Street, N. W., Washington, D. C.

United States Centennial of Engineering

PLANS for the United States Centennial of Engineering, which will mark the one-hundredth anniversary of the founding of the American Society of Civil Engineers, are under way and will involve a majority of the nation's engineering societies.

According to the most recent information available, some 30 organizations, including The American Society of Mechanical Engineers, are contemplating the scheduling of meetings in Chicago, Ill., from Sept. 3 to Sept. 13, 1952. The dates of the ASME meeting, which will be the 1952 Fall Meeting, are Sept. 8–11, inclusive.

Headquarters for the ASME Fall Meeting will be the Sheraton Hotel, on Michigan Boulevard. Because of the large number of engineers attending not only the ASME meeting but also the meetings of the other societies, members of ASME are urged to make reservations at once in order to avoid disappointment which delay may occasion.

Convocation Covers a Broad Field

As a part of the Centennial of Engineering, a Convocation is planned in which all engineers and the public as well will participate. The program of the Convocation, which starts on Wednesday, Sept. 3, and runs through Friday, Sept. 12, will feature prominent speakers on subjects vital to civilization and the American way of life in which engineering plays an important role. The essential economy of modern life will be considered under such broad categories as food, tools, transportation, metal industries, structures and construction, communications, energy, health, and urbanization, with attention also directed to education

and training and professional-society development.

Exposition Planned

It is planned to include as part of the Centennial an exposition with a dramatic presentation or pageant centered around the Museum of Science and Industry which already houses a large and educational collection of exhibits in the fields of science, engineering, and industry. It is expected that new exhibits covering a wide scope of engineering will be installed in the Museum by the time the Centennial is in progress.

Corporation Formed to Direct Over-All Phases

The American Society of Civil Engineers has announced that "engineering and industry will use this opportunity to make the Centennial an occasion of national and international significance." To direct the over-all phases of the celebration, the announcement states, "a special not-for-profit corporation, Centennial of Engineering, 1952, Inc., has been created, with its headquarters at the Museum of Science and Industry at Chicago, Ill. Lenox R. Lohr, Mem. ASCE, president of the Museum, is president of the Corporation. Charles F. Kettering, Hon. Mem. ASCE, is chairman of the executive committee. Necessary money for financing the general features of the celebration is being raised by the Corporation through contributions from industrial and manufacturing organizations."

Objectives of Centennial

The ASCE announcement concludes with a statement of three major aims directed principally to the general public and foreign visitors. "The Centennial will be designed," it asserts, "to make known the contributions of engineers to our national progress. It will depict clearly the role of industry, with its mass production and distribution, so essential to our high standard of living. Above all, it will attempt to demonstrate that an atmosphere of freedom and competition, with competent engineering and management in industry, is essential to maintain and increase the prosperity of the nation."

Important Notice to ASME Members

IF YOU are planning to attend the Centennial of Engineering to be held in Chicago, Ill., Sept. 3–12, 1952, during which time the Fall Meeting of the ASME will be held, Sept. 7–11, make your hotel reservations *without delay*. ASME headquarters will be the Hotel Sheraton, Michigan Boulevard.

Safety Committee Attains Division Status in ASME

Importance of Safety Engineering Cited

FORMATION of a Safety Division as one of the ASME Professional Divisions was recently approved by the Board on Technology, bringing the number of Divisions to 21.

Reasons for this change were the growing interest in such regulations as workmen's compensation laws, safety codes, and other regulations intended to improve the welfare of the American workingman. Also the necessity for concentrating on accident prevention became increasingly greater. As a result the number of safety engineers is rapidly becoming larger and their quality is reaching a level that qualifies them, in many cases, to be members of ASME. Safety engineers, in a relatively few years, will comprise a large proportion of the total number of engineering specialists and will represent a substantial potential source for new members to the Society. Because of social and governmental interests in the scientific advancement of safety engineering, this phase of engineering will continue to command more and more of the public's attention.

Until recently the organized safety activities of the Society were conducted by the Safety Committee under the jurisdiction of the Board on Codes and Standards. A review of the history of the Committee indicated that it was established to formulate codes and standards on elevators, compressed-air equipment, and the like. The development of such codes is a recognized and important activity of a safety-engineering group, but obviously does not encompass all that must be done.

The over-all program of the Safety Committee consisted of: Safety-code projects, participation in national safety organizations, integration of safety engineering in the mechanical-engineering curriculum, student-chapter programs, participation in ASME national conference schedules, safety articles for ASME publication, and a public-relations program.

An inspection of this program clearly indicated that the scope of the Committee's work was beyond that of formulating codes and standards. Because its work is so much broader than implied by its designation as a Committee of the Board on Codes and Standards and because many of its activities were conducted jointly with organizations of important standing, it was considered beneficial to the Society if the Safety Committee were so placed within the ASME organizational structure that the scope of its work would be indicated by its title. The establishment of a Professional Division for Safety will serve to achieve this purpose.

The Executive Committee of the Professional Division for Safety is composed of J. V. Grimaldi (1952), *chairman;* H. J. Loberg (1953); J. F. Lederer (1954); Hendley Blackmon (1955); N. W. Andrews, Jr. (1956).

CIOS Prepares for São Paulo Congress

PRELIMINARY plans for the next congress of the International Committee of Scientific Management to be held in São Paulo, Brazil, Feb. 20–25, 1954, were announced by M. E. Alvaro, deputy president, CIOS. Instead of 12 congress subjects, as was the case at the congress held in Brussels in 1951, there will be eight subjects in order to save congress time for multiple, small, afternoon discussion groups and to save space in the congress papers for larger utilization of the national contributions. The international papers will be of 15,000 words allowing 10,000 for the main international report and 5000 words for the reprint of most important elements of national contributions of the collaborating countries. Portuguese will be added as an official conference language to French and English.

Congress Subjects

The following eight subjects have been chosen, tentatively phrased, and assigned to the following countries present at the London meeting: Management methods of improving human relations, Belgium; direction and control of distribution activities, The Netherlands; controls for top-management's use, Switzerland; executive development and training, Italy; developing an effective and co-operative organization structure, Sweden; policy-making as affected by social and political considerations, France; direction and use of technics of work organization, United States; and measurement of productivity, United Kingdom. This repartition followed the principle that no country should treat the same field in São Paulo as in Brussels.

Plan Interim Regional Conferences

Although the 16 CIOS committees will be busy during the coming years with the preparations for the São Paulo Congress, several of them plan to organize important extensive regional conferences. The following were also announced at the London meeting of the Executive Committee and were taken formally under CIOS auspices: Pacific regional conference, Australia; Internationale Arbeitswissenschaftliche Tagung, spring, 1952, Austria; Pan-American regional conference, Oct.–Nov., 1952, São Paulo, Brazil; Royaumont conference, June, 1952, and European regional conference, spring, 1953, Paris, France; National conference with invitations to foreigners, October, 1952, Torino, Italy; and National conference with overseas speakers, March 17–22, 1952, Cape Town, South Africa.

ASTM Fiftieth Anniversary

THE fiftieth anniversary of the American Society for Testing Materials will be celebrated as part of the ASTM annual meeting to be held in New York, N. Y., June 23–27, 1952. Two exhibits, the Tenth Exhibit of Testing Apparatus and Laboratory Supplies, and the biennial Photographic Exhibit, will be held concurrently with the meeting.

Midwest Power Conference Renamed American Power Conference

THE Midwest Power Conference has been renamed the American Power Conference, it was announced recently. The 13 annual Midwest Power meetings have attained wide geographical and scientific significance.

The first annual American Power Conference will be held March 26–28, at the Sherman Hotel, Chicago, Ill. Illinois Institute of Technology will continue to sponsor the meeting and the same group of schools and societies will participate. These are: Iowa State College, Michigan State College, Northwestern University, Purdue University, State University of Iowa, University of Illinois, University of Michigan, University of Minnesota, University of Wisconsin; Chicago sections of the American Institute of Chemical Engineers, American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers; Illinois section of the American Society of Civil Engineers; Illinois chapter of the American Society of Heating and Ventilating Engineers, Western Society of Engineers, Engineers' Society of Milwaukee, and the National Association of Power Engineers.

The Edison Association of Illuminating Companies and the Edison Electric Institute will join the list of co-operating groups in 1952.

1952 British Industries Fair

THE 1952 British Industries Fair will be held in London and Birmingham, England, May 5–16, according to announcement in London.

Plans are under way to increase the 1951 high figure of 19,266 overseas visitors for the 1952 exhibition. This is the largest overseas attendance in the 36-year history of the Fair.

The 1952 Fair will again occupy three exhibit halls, Earl's Court and Olympia in London, and Castle Bromwich in Birmingham. Every square foot of exhibit space in the three buildings was utilized last year by nearly three thousand British manufacturer exhibitors, with a large outdoor area in Birmingham being allocated to road-construction and other heavy machinery.

The engineering and hardware section will be located at Castle Bromwich, in Birmingham, and will consist of groups on hardware, building, electricity, engineering, metals, mining, transport, and gas equipment.

Special train service between London and Birmingham will be provided as in the previous years.

EJC Officers for 1952

T. G. LEE CLAIR, chief electrical engineer, Commonwealth Edison Company, Chicago, Ill., and past-president, American Institute of Electrical Engineers, will serve as president of Engineers Joint Council for 1952.

Other EJC officers for 1952 are: T. H. Chilton, past-president, American Institute of Chemical Engineers, *vice-president;* H. H. Henline, secretary AIEE, *secretary;* and E. L. Chandler, assistant secretary, American Society of Civil Engineers, *treasurer.*

Representatives of The American Society of Mechanical Engineers on Engineers Joint Council for 1952 are: J. Calvin Brown and James D. Cunningham, past-presidents; C. E. Davies, secretary; and James M. Todd, E. G. Bailey, and R. M. Gates, *alternates.*

ASME Spring Meeting in Seattle

MOUNT RAINIER FROM CHINOOK PASS

(Situated in beautiful Mount Rainier National Park, a paradise of flower-carpeted meadows, verdant forests, glacial rivers, and cascading waterfalls, Mount Rainier, the year-round snow-capped monarch, presents a memorable picture visible in Seattle on a clear day. Seattle, long a gateway to the Orient, is a busy seaport, railroad and aviation center, and industrial city. In its century of progress Seattle has encouraged educational and cultural development. An excellent example is the University of Washington, the site of the ASME Spring Meeting to be held March 24–26, 1952.)

National Science Board Elects Chairman and Vice-Chairman

CHESTER I. BARNARD, president of the Rockefeller Foundation, was elected chairman of the National Science Board of the National Science Foundation at its second annual meeting held in Washington recently. Mr. Barnard succeeds James B. Conant, president of Harvard University, who was the first chairman of the Board, elected to serve the initial term which began Dec. 12, 1950. Edwin B. Fred, president, University of Wisconsin, was re-elected vice-chaiman of the National Science Board. The new chairman and vice-chairman were elected for two-year terms of office as prescribed by the National Science Foundation Act of 1950.

Four members of the Executive Committee, whose terms had expired, were also re-elected. These were: Mr. Barnard; Detlev Bronk, president, Johns Hopkins University, and president, National Academy of Sciences; Lee A. DuBridge, president, California Institute of Technology; and Elvin C. Stakman, chief, Division of Plant Pathology and Botany, University of Minnesota.

The Executive Committee consists of nine members to be chosen by the National Science Board, and the director of the National Science Foundation, member ex officio. The other five members of the Executive Committee are: Dr. Conant; Paul M. Gross, vice-president, Duke University; Robert F. Loeb, director of medical services, Presbyterian Hospital, New York; J. C. Morris, vice-president, Tulane University; and Alan T. Waterman, director of the Foundation. The smaller group is authorized to act for the 24-member National Science Board in such matters as the Board desires, with the exception of the establishment of policy or the review and approval of major matters. Members are elected to the Executive Committee for a two-year term.

Gas Institute Reviews Ten Years of Progress

THE Institute of Gas Technology, Chicago, Ill., now in its second decade of operation, recently issued a report reviewing its work during the last ten years. The Institute, a combined educational and research organization, was founded by members of the American Gas Association in 1941 to train men for the gas industry, for fundamental and applied research in gas technology, dissemination of scientific information, and co-ordination of research

within the gas industry. The ten-year report shows that the Institute has spent $293,000 on its educational program and almost two million dollars on gas-industry research projects. Since World War II the Institute has added a new building and a pilot plant to its facilities.

Resistance-Welding Contest Announced

A TOTAL of $2250 in prizes for outstanding papers on resistance-welding subjects will be awarded during the 1952 Prize Paper Contest of the Resistance Welder Manufacturers Association, it was announced recently. Separate prizes will be awarded to papers from engineers in industry and research laboratory work, papers from a university source, and those from undergraduate students. Papers on achievements in resistance-welding design, application, or research will be considered. The contest closes July 31, 1952. Awards will be made at the 1952 Fall Meeting of the American Welding Society. For further details, write the Resistance Welder Manufacturers Association, 1900 Arch Street, Philadelphia 3, Pa.

ASME Calendar of Coming Events

March 24–26, 1952
ASME Spring Meeting, University of Washington, Seattle, Wash.
(Final date for submitting papers was Nov. 1, 1951)

June 15–19, 1952
ASME Semi-Annual Meeting. Sheraton-Gibson Hotel, Cincinnati, Ohio
(Final date for submitting papers was Feb. 1, 1952)

June 19–21, 1952
ASME Applied Mechanics Division Conference, The Pennsylvania State College, State College, Pa.
(Final date for submitting papers was Feb. 1, 1952)

June 23–27, 1952
ASME Oil and Gas Power Division Conference, Hotel Statler, Buffalo, N. Y.
(Final date for submitting papers was Feb. 1, 1952)

June 26–28, 1952
ASME Applied Mechanics Division, West Coast Conference, University of California, Los Angeles, Calif.
(Final date for submitting papers was Feb. 1, 1952)

Sept. 8–11, 1952
ASME Fall Meeting, Sheraton Hotel, Chicago, Ill.
(Final date for submitting papers—May 1, 1952)

Sept. 8–12, 1952
ASME Industrial Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Cleveland Auditorium, Cleveland, Ohio
(Final data for submitting papers—May 1, 1952)

Sept. 22–24, 1952
ASME Petroleum Mechanical-Engineering Conference, Hotel President, Kansas City, Mo.
(Final date for submitting papers—May 1, 1952)

Oct. 30–31, 1952
ASME Fuels and AIME Coal Divisions Joint Conference, Bellevue-Stratford Hotel, Philadelphia, Pa.
(Final date for submitting papers—June 1, 1952)

Nov. 30–Dec. 5, 1952
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(Final date for submitting papers—July 1, 1952)
(For meetings of Other Societies see page 177)

ECPD Annual Report for 1951 Now Available

THE nineteenth annual report of the Engineers' Council for Professional Development, for the year ending Sept. 30, 1951, is now available. It contains the reports of the chairman, the standing and special committees, the representatives of the constituent societies; also lists of accredited undergraduate engineering curricula and technical institute programs; and the financial statement for the year 1950–1951. Included in the 60-page report are: The Charter and Rules of Procedure under which ECPD operates; lists of officers, representatives, and committee personnel; a list of ECPD publications; and the Canons of Ethics for Engineers.

The report of the chairman, H. S. Rogers, titled "Service, Motivation, and Support," which summarizes the high lights of the Council's work and the reports of its committees, was printed in the December, 1951, issue of MECHANICAL ENGINEERING, pages 998–999.

Special interest attaches to a supplementary report of the Education Committee, "Graduate Education in Engineering," and to the report of a special Committee on Adequacy and Standards of Engineering Education, which was printed in the January, 1952, number of MECHANICAL ENGINEERING, pages 15–18.

The report of the Guidance Committee describes briefly the plan of regional guidance committees which were set up on a regional and state basis all over the United States during 1951. Further discussion of the problems of guidance will be found in an article, "Wanted—Engineers," by Willis F. Thompson, vice-president, Region I, ASME, who served as chairman of the ECPD Guidance Committee in 1951, which appeared in MECHANICAL ENGINEERING, December, 1951, pages 989–991.

The list of accredited undergraduate engineering curricula is in two parts: One by institutions and the other by curricula, including options in major curricula paralleling specialized curricula. Lists of accredited curricula are brought up to date every year at the annual meeting of ECPD, held in late October. Since changes appear in each year's list, current lists should be consulted in locating accredited curricula and the institutions in which engineering curricula have been accredited.

Copies of the annual report may be purchased from Engineers' Council for Professional Development, 25–33 West 39th St., New York 18, N. Y. The lists of accredited undergraduate curricula are also available as separate reprints of that section of the annual report.

Long Island Division Holds First Dinner Meeting

A LARGE group of Long Island engineers recently heard J. Calvin Brown, 1951 president ASME, discuss significant events in the lives of several great American inventors and point out some basic reasons for this country's unique technological development. Mr. Brown spoke at the first dinner meeting of the newly formed Long Island Division of The American Society of Mechanical Engineers held at the North Hempstead Country Club. His topic was "Great Inventions and the Story Behind Them."

J. CALVIN BROWN, 1951 ASME PRESIDENT, ADDRESSING ENGINEERS AT LONG ISLAND DIVISION DINNER RECENTLY

According to Mr. Brown, our patent system, begun in colonial times, is greatly responsible for our technological growth and present leadership. Without its protection, he said, few financiers would have invested their money in the tools which produced our wealth. H. R. Kessler, vice-president, ASME Region II, was chairman of the meeting, which concluded with an amateur musical show and group singing.

The ASME Long Island Division, established last July to serve engineers on Long Island, is composed mainly of younger engineers. Besides being organized into several technical and professional committees concerned with such subjects as aviation, instrumentation, civic responsibilities, and building codes, the Division is setting up liaison committees to co-operate with other Long Island groups. Edlow S. Bance, 77 Terrace Avenue, Hempstead, L. I., is chairman.

Boston ASME Section Holds Triple-Interest Meetings

LAST fall the Boston Section of The American Society of Mechanical Engineers held the first of a series of "Triple-Interest" Meetings in order better to serve the diversified interests of its members.

The pattern of these meetings calls for a social hour and dinner in which all members participate. After the dinner, three concurrent sessions are held, each devoted to a different subject.

At the first Triple-Interest Meeting the three sessions were devoted to: (1) Applied Mechanics, with a paper by Dr. Eugene W. Pike, head of applied physics section, Raytheon Manufacturing Company; (2) Juniors, with a discussion of the subject, "When to Change

Jobs," led by Prof. C. Richard Soderberg, head, mechanical-engineering department, Massachusetts Institute of Technology; and (3) Power, with a paper, "Boiler-Design Problems," by H. G. Stallkamp, project manager, contract department, The Babcock & Wilcox Company.

At the second of the series of Triple-Interest Meetings the sessions were devoted to the fields of power, machine design, and applied mechanics.

Council Acts on Mexico Group

SECTION status has been granted for a two-year period to the Mexico Group as a result of Council action taken during the meeting held concurrently with the ASME Annual Meeting in Atlantic City, N. Y.

Council voted: (1) To give the Mexico Group Section status within Region VIII for a period of two years starting Oct. 1, 1951, to Sept. 30, 1953, to be extended at the discretion of the Council. (2) That in the payment of dues the difference in exchange between a peso value of 20 cents (1948 par basis) and the current rate of exchange be absorbed by the Society but the limit is not to exceed 40 per cent of the exchange difference. Under this arrangement the members will remit in American dollars. (3) That the Section send one delegate to attend the Regional Administrative Committee Meeting; that the Society pay per diem travel expenses from the closest point of entry to U.S.A. to the place of the RAC meeting. (4) That the Mexico Section will be supported at the rate of exchange in which the dues are accepted.

1952 RAC Meetings Announced

BETWEEN March 24 and April 27, 1952, all Sections of The American Society of Mechanical Engineers will send delegates to eight Regional Administrative Committee Meetings, one to each of the ASME Regions, to discuss regional and national problems, as well as to consider and act upon items submitted by various sections. This material is compiled by the Agenda Committee.

This year Region VII will hold its RAC meeting as part of the events planned for the 1952 ASME Spring Meeting to be held at the University of Washington, Seattle, Wash., March 24-26, 1952.

In the fall of each year the ASME Agenda Committee invites each Section to suggest topics for discussion for the next Conference. These items are tabulated by the Agenda Committee and sent to each of the ASME Sections for approval. Items approved by 15 or more sections are placed on the final agenda for consideration by the Regional Administrative Committees. Items approved by a majority of the RAC meetings are then placed on the agenda of the Regional Delegates Conference. Each delegate to these meetings and the Conference receives a mileage and per diem allowance from the National Society toward his expenses. Two delegates from each region are selected to carry actions of that region to the Regional Delegates Conference held at the time of the Semi-Annual Meeting. The actions of this Conference are referred to Council for final disposition.

Wood Industries Division Embarks on Standardization Program

THE Wood Industries Division, ASME, is considering the possibilities of the standardization of dimensions of woodcutting instruments, tools, and equipment. The project on the standardization of saw arbors was turned over to the Association of Manufacturers of Woodworking Machinery more than a year ago for further study, with the recommendation that it be adopted by the American Standards Association, according to a report submitted by T. D. Perry, chairman, Special Committee. Lively interest in this project is maintained despite the problems created by war-induced scarcity of raw material.

The standardization of carbide-tipped tools was a project brought to the attention of the Society by industry itself. So far it has related to unground knife blank standards which are based on an industry survey, as well as on saw-tip standards, developed by a committee within the industry. The next step is the development of a larger committee representing the manufacturers of woodworking machinery using these carbide products, and the users of woodworking machinery equipped with such carbide tools. Prof. E. S. Johnson is in charge of this committee.

These preliminary standards have been published in *Wood*, July, 1951.

More Science Training Needed in U. S.

EUROPE looks to America for leadership in the engineering science as well as in other fields, according to John R. Dunning, Mem. ASME, dean, school of engineering, Columbia University, New York, N. Y.

Dr. Dunning recently warned that the United States must move quickly to fill the vacuum in engineering left by the second World War.

"While this country has excelled in the training of engineers, American industry has relied on Europe to train scientists responsible for more fundamental work," Dr. Dunning said. "Engineering schools, while maintaining the practical approach, must emphasize more heavily in the future the fundamental aspects of engineering education."

"Since the war," Dr. Dunning pointed out, "American engineers have been going abroad in increasing numbers to aid our allies and observe European methods and problems. Lately European engineers have been coming to the United States in increasing numbers to study our engineering education and production methods. This interchange is excellent for all of us.

"But—wholesome as this is—it is not enough. The basic need today is for an educational system in engineering that stresses the fundamental discoveries, as well as the practical applications.

"We must be able to do both," he concluded, "if our society is to survive in this period."

ASEE Solicits Teaching Aids

THE American Society for Engineering Education is issuing a call to industry, the professional societies, public or private research organizations, and the engineering colleges for teaching aids which may be reviewed in its forthcoming Catalog of Teaching Aids. This publication, which is being prepared by the society through its Committee on Teaching Aids, will contain reviews of all kinds of teaching aids suitable for use in the teaching of various engineering subjects. The first edition of the catalog will be limited to civil, electrical, and mechanical engineering, mathematics, and engineering mechanics. This edition will also be limited to motion-picture films (sound and silent), slides in 2 × 2 in. or 3¼ × 4 in. size, models, charts, and exhibits. Information on such devices should be sent to Prof. Carl W. Muhlenbruch, chairman, ASEE Committee on Teaching Aids, Northwestern Technological Institute, Evanston, Ill., who will see that they reach the proper reviewing group. Each offer of a teaching aid should be accompanied by a written description or

1952 Regional Administrative Committee Meetings

Region	*Location*	*Meeting Place*	*Days*	*Date*
I	Bridgeport, Conn.	University of Bridgeport	Fri-Sat	April 18-19
II	New York, N. Y.	Headquarters	Thurs-Fri	April 3-4
III	Corning, N. Y.	Baron Steuben Hotel	Tues-Wed	April 15-16
IV	Raleigh, N. C.	Sir Walter Hotel	Sun-Mon	March 30-31
V	Dayton, Ohio	Biltmore	Wed-Thurs	April 9-10
VI	Davenport, Iowa	Blackhawk Hotel	Fri-Sat	April 25-26
VII	Seattle, Wash.	University of Washington	Sun	March 23
VIII	Denver, Colo.	Albany Hotel	Sun	April 27

photograph and a set of operating instructions.

The chief purpose of the ASEE Catalog of Teaching Aids will be to help the engineering teacher choose those teaching aids which most suit his particular needs and to provide him with the assurance that they have been passed upon by competent individuals.

The Committee asks that teaching aids, not "training aids," be submitted for review in the catalog. The training aid has its uses in teaching workers in industry how to perform certain manual operations, but in educating engineers it is necessary to provide the student with an understanding of the fundamentals of the subject being studied. For this reason the training aid is not applicable to engineering education. Instead, what is needed are teaching aids, which enable the student to grasp more quickly the fundamentals of the science of engineering and then to apply them to the solution of actual problems.

Any industrial or research organization, engineering teacher, or anyone else having a teaching aid which satisfies the above conditions in the fields mentioned is urged to submit the device to the Committee on Teaching Aids for consideration. If found acceptable by the committee of engineering educators who examine it, the teaching aid will be reviewed and listed in the ASEE Catalog of Teaching Aids.

Engineering Literature

Bituminous Coal

THE Bituminous Coal Institute, Washington, D. C., recently issued its 1951 Bituminous Coal Annual. The fourth edition of the annual is much more than a dry compendum of facts and figures or a handbook for statisticians and economists. It is authentic, informative, and contains interesting data about an industry vital to the mobilization program—bituminous coal. This 204-page volume, which follows the general pattern of its three predecessors, has many photos, charts, and graphics printed in color.

The text of the annual without the illustrations and tabulations has been published by BCI as a separate booklet under the title, "Powering America's Progress."

Employment and Earnings of American Men of Science

THE United States Department of Labor, Bureau of Labor Statistics, in co-operation with the U. S. Department of Defense, has recently issued Bulletin No. 1027, "Employment, Education, and Earnings of American Men of Science."

The report covers information resulting from a questionnaire survey involving 42,000 of the nation's top scientists. The text material, which discusses the findings, relates to fields of specialization, level of education, region of education, type and region of employment, and earnings, supported by many tables and charts.

The report is for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., and is priced at 45 cents.

Instrumentation

THE Proceedings of the First Annual Conference on Instrumentation for the Iron and Steel Industry, which was held at Pittsburgh, Pa., March 28–29, 1951, sponsored by the Carnegie Institute of Technology and the Pittsburgh Section, Instrument Society of America, in co-operation with eight engineering and technical societies, including The American Society of Mechanical Engineers, have been published in pamphlet form. Copies may be purchased from The Instruments Publishing Company, Inc., 921 Ridge Avenue, Pittsburgh 12, Pa.

Buckling of Columns

A PAPER by Prof. Mirko Ros, "Buckling of Columns," has been translated by the Column Research Council and is now available. The report contains over 60 photographs and curves, which summarize research on buckling of columns carried out over a 25-year period at the Federal Laboratory of Testing Materials, Zürich, Switzerland. Discussed in the paper are the following subjects: Process of buckling under concentric and eccentric load, test results, evaluation of assumptions, tests on full-sized structures, allowable buckling stresses—safety factors, and design of built-up members.

Professor Ros was former president of the board, Federal Laboratory for Testing Materials and Institute of Research, Zürich.

Copies of the report may be obtained at a cost of $1 by addressing the secretary, Lynn S. Beedle, Fritz Engineering Laboratory, Lehigh University, Bethlehem, Pa.

ASME Standards Workshop

OBSERVING Standards Week, Oct. 22–27, 1951, several of the ASME standards committees met at ASME headquarters or at the Waldorf-Astoria Hotel, where the American Standards Association meeting was in session.

Industrial Power Trucks

SECTIONAL Committee B56 on Safety Code for Industrial Power Trucks met Oct. 17, 1951, and noted that almost 4000 copies of the B56 Code had been sold during the first two months following its publication—making it second in popularity to the elevator code. Manufacturers as a group are complying with the code except where their customers require special equipment. It was recommended that copies of the code be distributed to State authorities for consideration and adoption. It was further agreed that the problem of manufacturing a truck capable of operating in hazardous areas should be given consideration. To date no manufacturer has designed a truck at any cost to completely accomplish the purpose.

Abbreviations

SECTIONAL Committee on Abbreviations Y1 met at headquarters on Oct. 22, 1951, and appointed three subcommittees: One each to review two active standards and the third to decide where additional standards are needed. The elected officers are S. A. Tucker, chairman; Rupert Le Grande, vice-chairman; and J. J. Costa, secretary. The work of Y1 is limited to the field of abbreviations of terms used in engineering and physical sciences and technology.

Drafting Practices

AT A meeting of the Executive Committee of Y14 on Standards for Drawings and Drafting Practice, M. Lamanno, structural engineer, Allied Processes, New York, N. Y., was elected chairman of Subcommittee No. 14 on Structural Drafting. The Executive Committee released one of the seventeen sections of "American Drafting Standards Manual," a standardization project, which when completed will cover the standardization of all aspects of engineering drawing and drafting practice, for industry's comment prior to consideration as an American standard on pictorial drawing. Comments should be addressed to D. M. Shackelford, ASME, 29 West 39th St., New York 18, N. Y.

Rings

SECTIONAL Committee on Washers and Machine Rings, B27, Subcommittee No. 3 on Snap, Retainer, and Bearing Rings, held an organization meeting, Oct. 24, 1951, at headquarters, for the purpose of outlining a program looking toward the standardization of snap rings, machine rings, bearing rings, and others. E. D. Cowlin serves as chairman of this subcommittee.

People

FENTON B. TURCK, Mem. ASME, president Turck, Hill and Co., Inc., of New York, N. Y., has established a series of lectures on distribution in the Department of Industrial Administration at Yale University. The initial Turck Lecture was delivered by Armstrong A. Stambaugh, chairman of the board, The Standard Oil Company of Ohio, on Dec. 10, 1951.

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L. WEST SHEA, manager, Materials-Handling Sales Division, The Union Metal Manufacturing Company, Canton, Ohio, was elected to the post of president of The Material Handling Institute, Inc., and its 78 member companies,

at the annual MHI meeting held in New York, N. Y., on Dec. 12, 1951.

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FARRINGTON DANIELS, professor of chemistry, University of Wisconsin, and one of the country's leading atomic scientists, was elected president of the American Chemical Society for 1953.

* * *

HERBERT HOOVER, former President of the United States, and Hon. Mem. ASME, received a citation in which he was designated "the most illustrious member" of the engineering profession by 75 national-professional and scientific societies. Mr. Hoover, who is celebrating his 60th anniversary as an engineer, received the citation from James Creese, Assoc. ASME, president of Drexel Institute of Technology, Philadelphia, Pa.

The citation bore the signatures of 650 national officers of the various societies. The signers recently attended the 60th anniversary convocation of Drexel Institute.

* * *

DANIEL C. DRUCKER, associate professor of engineering, Brown University, and Ernest L. Midgette, head of the department of mechanical engineering, Polytechnic Institute of Brooklyn, members of the ASME, were recently appointed as members of the Picatinny Arsenal Scientific Advisory Council. The Council is an organization authorized by the Ordnance Corps to help the Army's ammunition research and development installation.

* * *

CHARLES P. HOWARD, of Picstown, S. D., has been awarded Humble Oil and Refining Company's graduate fellowship in mechanical engineering at A&M. College of Texas for the 1951-1952 school year. This is the second term that he has been given the company's fellowship in this field.

* * *

C. S. CROUSE, head, department of mining and metallurgy, University of Kentucky, was elected president of the National Council of State Boards of Engineering Examiners, at the 30th annual meeting of NCSBEE held in Boston, Mass., Oct. 21-24, 1951.

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D. B. STEINMAN, bridge engineer and authority on the design of suspension bridges, received the Norman Medal for his paper on "Aerodynamic Theory of Bridge Oscillations," on Oct. 24, 1951, at the American Society of Civil Engineers annual convention, which was held in New York, N. Y.

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ANDREW B. HOLMSTROM, Mem. ASME, vice-president, general manager, Abrasive Division, Norton Company, was re-elected mayor of Worcester, Mass.

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CHARLES F. WAGNER, consulting engineer, Westinghouse Electric Corporation, was named as recipient of the 1951 Edison Medal for "distinguished contributions in the field of power-system engineering," by the American Institute of Electrical Engineers. The medal will be presented during the winter general meeting of the Institute at the Hotel Statler, New York, N. Y., Jan. 21-26, 1952.

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WELLWOOD E. BEALL, vice-president, engineering and sales, Boeing Airplane Company, has been elected president of the Institute of the Aeronautical Sciences for 1952.

Four IAS vice-presidents were elected as follows: Preston R. Bassett, president, Sperry Gyroscope Company, division of The Sperry Corporation; Smith J. De France, director, Ames Aeronautical Laboratory, National Advisory Committee for Aeronautics, Moffett Field, Calif.; Edward H. Heinemann, chief engineer, El Segundo Division, Douglas Aircraft Company, Inc.; and John C. Leslie, vice-president, Pan American World Airways System. The 1952 treasurer is Charles H. Colvin, vice-president, G. M. Giannini and Company, Inc.

S. Paul Johnston, Mem. ASME, was re-elected director of the Institute; Robert R. Dexter, was re-elected secretary; and Joseph J. Maitan, was re-elected controller.

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CHARLES W. MACGREGOR, Mem. ASME, professor of applied mechanics and head, materials division, Massachusetts Institute of Technology, has been named vice-president of the University of Pennsylvania in charge of engineering and scientific studies.

In the office at Pennsylvania, newly created by the trustees, Dr. MacGregor will have jurisdiction over the engineering and scientific departments of the University. His administration will also include the Towne Scientific School and the Moore School of Electrical Engineering.

* * *

EDWARD SIMONS, consulting engineer, San Francisco, Calif., was installed as president of the American Society of Refrigerating Engineers at the 47th annual meeting of the Society held in New Orleans, La., Dec. 5, 1951.

Other officers of ASRE during the ensuing year will be: Vice-presidents, Richard C. Jordan, Mem. ASME, head, department of mechanical engineering, University of Minnesota; Arthur J. Hess, partner, Hess, Greiner, and Polland, Los Angeles, Calif.; treasurer, Donald K. Tressler, scientific director, Quartermaster Food and Container Institute for the Armed Forces, Chicago Quartermaster Depot. The following directors were elected for a period of three years: H. C. Diehl, director, Refrigeration Research Foundation, Colorado Springs, Colo.; Walter A. Kuenzli, assistant to director of appliance engineering, Crosley Division, Avco Corporation, Cincinnati, Ohio; John M. Lambert, manager, consumer sales, York Corporation, York, Pa.; Daniel D. Wile, chief engineer, Refrigeration Engineering Inc., Los Angeles; Howard H. Peterson, consulting engineer, Yakima, Wash. Elected director for a one-year term to fill the unexpired term of Arthur J. Hess, was J. R. Hornaday, chief engineer, Norge Division, Borg-Warner Corporation, Muskegon Heights, Mich.

* * *

WILLIAM I. BURT, vice-president, manufacturing, The B. F. Goodrich Chemical Company, Cleveland, Ohio, has been elected president of the American Institute of Chemical Engineers for 1952. William T. Nichols, director, general engineering department, Monsanto Chemical Company, was elected vice-president, and Stephen L. Tyler and C. R. DeLong, both of New York, N. Y., were re-elected executive secretary and treasurer, respectively.

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A. A. POTTER, Hon. Mem. and past-president, ASME, was among the one hundred men and women to receive the Northwestern University Centennial Award for their distinguished service to society while residing in one of the following states: Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin. These states composed the Northwest Territory from which Northwestern took its name one hundred years ago. The list of honorees includes other members of the Society. They are Ralph Budd, Hon. Mem. ASME; Henry T. Heald, Mem. ASME; and Charles F. Kettering, Fellow ASME. The Centennial Convocation was held Dec. 2, 1951, in Cahn Auditorium, Evanston, Ill. J. T. Rettaliata, vice-president, ASME, represented the Society at the Convocation.

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HARRY S. ROGERS, Mem. ASME, president, Polytechnic Institute of Brooklyn since 1933, was elected a director of the New York Telephone Company. Dr. Rogers is chairman of the Engineers' Council for Professional Development.

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JEROME C. HUNSAKER, Hon. Mem. and vice-president, ASME, 1939-1941; chairman, National Advisory Committee for Aeronautics, and head, aeronautical-engineering department, Massachusetts Institute of Technology, received the Wright Brothers Memorial Trophy at the annual Wright memorial dinner, at the Statler Hotel, Washington, D. C., Dec. 17, 1951.

Meetings of Other Societies

Feb. 18-21
American Institute of Mining and Metallurgical Engineers, annual meeting, Hotel Statler, New York, N. Y.

Feb. 28-29
Pennsylvania Electric Association, joint meeting of the prime movers and electrical equipment committees, Benjamin Franklin Hotel, Philadelphia, Pa.

March 3-6
Institute of Radio Engineers, annual convention, Waldorf-Astoria Hotel and Grand Central Palace, New York, N. Y.

March 3-7
American Society for Testing Materials, spring meeting and committee week, Hotel Statler, Cleveland, Ohio

March 5-7
American Society of Civil Engineers, New Orleans convention, St. Charles Hotel, New Orleans, La.

March 17-21
American Society of Tool Engineers, industrial exposition, International Amphitheatre, Chicago, Ill.

(For ASME Calendar of Coming Events see page 174)

1952 Society Records Sent Upon Request

MEMBERS of the American Society of Mechanical Engineers who wish to receive copies of the 1952 issue of "Personnel of Council, Boards, and Committees: With Other ASME Records (AC-10)" are requested to write to the Secretary, ASME, 29 West 39th Street, New York 18, N. Y.

Education

Oak Ridge Offers Course in Reactor Technology

INDUSTRIAL organizations interested in obtaining special training in nuclear-reactor technology for experienced engineers in their employ are invited to sponsor their enrollment in the 1952–1953 session of the Oak Ridge School of Reactor Technology. The deadline for experienced engineer applicants is March 1, 1952, and the school term begins the following Sept. 8.

Further information and application forms may be obtained by writing to the Director, Oak Ridge School of Reactor Technology, P.O. Box P, Oak Ridge, Tenn.

Since much of the material presented in the curriculum of the Oak Ridge School of Reactor Technology is classified, all enrollments are contingent upon a personal-security investigation. Announcements of appointments will be made on or before April 1.

Applications for Sloan Fellowships at M.I.T. Due Feb. 23, 1952

PLANS for a nationwide competition for 14 Sloan Fellowships entitling recipients to participate in the executive development program at the Massachusetts Institute of Technology were announced recently by E. P. Brooks, dean of M.I.T.'s new school of industrial management.

The fellowships are awarded to outstanding young executives under a program which was established more than 20 years ago by grants from the Alfred P. Sloan Foundation. The program covers a year of advanced study in economics and business administration at the Institute to prepare men for higher executive responsibility.

In announcing the 1952 fellowships, Dean Brooks said: "This executive development program offers unusual opportunities for supplementing the practical industrial experience in the development of unusually able young men toward positions of higher responsibility in industry. This program, initiated at M.I.T. over 20 years ago will now become part of our new school of industrial management."

Nomination by an employer is prerequisite for application for a Sloan Fellowship since employers co-operate in the program both by sponsoring outstanding young men and by providing successful candidates with a year's leave of absence. Fellows are drawn from both large and small companies in various types of industry.

Applications for the awards must be made at M.I.T. by Feb. 23, 1952. Candidates must be between the ages of 30 and 35 and they should have at least five to ten years of industrial experience, with part of this experience in an executive capacity. Fellowship winners will be selected on a competitive basis by M.I.T. after consideration of the applicants' records and references and after consultation with their employers. Awards range up to $3720 for married men and to $2720 for those who are single. Fellows will be in residence at the Institute in Cambridge, Mass., from June, 1952, to June, 1953.

H. W. Gillett Memorial Lecture Established by ASTM and Battelle Memorial Institute

THE American Society for Testing Materials has announced the establishment of an annual H. W. Gillett Memorial Lecture. The purpose of this lecture, which is being sponsored in co-operation with Battelle Memorial Institute, is to commemorate Horace W. Gillett, who was one of America's leading technologists, the first director of Battelle in Columbus, Ohio, and an active worker for many years in ASTM.

The memorial lecture will be delivered annually at a meeting of the society, the first to be given at ASTM's 50th anniversary meeting in New York, N. Y., during the week of June 23, 1952. The lecturer, who will be selected through a committee appointed by the ASTM Board of Directors, will cover a subject pertaining to the development, testing, evaluation, and application of metals.

New Laboratory at Princeton

A NEW $275,000 engineering laboratory was recently dedicated at Princeton University, Princeton, N. J. The laboratory, named in honor of the late James E. Hayes, an alumnus of Princeton, will be used for mechanical-engineering studies. When completed, the new building will include an Instruction Machine Shop, a Maintenance Machine Shop, and an advanced engineering laboratory.

National Science Foundation Issues Tentative Guide for Prospective Grantees

THE first draft of a guide to assist scientific research investigators in the preparation of proposals for National Science Foundation research grants has been issued by the Foundation. Copies of the guide will be distributed widely to universities and colleges, laboratories, and other organizations in a position to carry on competent scientific research.

The Foundation will support basic research in the mathematical, physical, medical, biological, and engineering sciences, by making grants for such research to educational, industrial, governmental, or other institutions or individuals. Ordinarily grants would be awarded to institutions for research by specified individuals.

In reviewing proposals the Foundation will emphasize the scientific merit of the suggested research, including the competence of the scientist under whom the study will be made.

During the current fiscal year the Foundation has earmarked approximately $1,500,000 for support of basic scientific research.

Engineering Student Registration in Canada

A RECENT survey made by The Engineering Institute of Canada has disclosed that first-year registration of engineering students at Canadian universities in 1951 was up more than 10 per cent over 1950.

While the total enrollment of engineering students is down again this year from 8329 last year to 7509, the trend has been reversed and the number of first-year registrations is 2105 as compared to 1874 in 1950. On the basis of nonveteran enrollment in first year the figures are 2086 for 1951 and 1831 for 1950, giving a net increase this year of 255 or 14 per cent over the 1950 figure.

The number of prospective 1952 graduates is down considerably from 1951. The prospects for employment of young graduate engineers next spring should be excellent. The shortage is not likely to be eliminated for quite a number of years unless the present level of engineering employment drops very appreciably in the meantime. The number of prospective graduates in 1951 was 2450, 1952 will be 1717, and in 1953 will be, approximately, 1450.

When it is considered that Canada has been absorbing engineering graduates at a rate of more than 3000 per year for the past four years, the fact that fewer than 1500 per year are likely to be available during the next four years is bound to have an appreciable effect on the economic use of engineers by industry. That there will be a continuing shortage of engineers to meet the demand in the next few years seems particularly certain.

The relative proportion of total registration in different courses shows very little change from that of the previous two years.

Coming Meeting Notes

ISO to Meet at Columbia University, June 9–21, 1952

THE International Organization for Standardization (ISO) will hold its triennial meeting at Columbia University in New York, N. Y., June 9–21, 1952.

Delegates from the 32 member nations will

take part in the ISO General Assembly, which last met in Paris in 1949. Meetings of the ISO Council and a number of its technical committees will also be held during the two-week session.

The ISO is the international clearinghouse for the national standards bodies of most industrial countries.

It is recognized by the United Nations as the authoritative channel through which standardization on an international level is carried out.

M. Albert Coquot, president, French Standards Association, is president of ISO. The secretary general is Henry St. Leger, with headquarters in Geneva, Switzerland.

Instrumentation

PLANS are now under way for the 1952 National Instrument Conference and Exhibit to be held in Cleveland, Ohio, Sept. 8–12, it was announced recently by the Instrument Society of America.

Junior Forum

Developing An Engineer

By Joseph Schmerler[1]

THE problem of developing an engineer after graduation from an engineering school is of profound concern to management as well as to the graduate himself. The Junior Forum, MECHANICAL ENGINEERING, January, 1952, pp. 95–96, contained a report of how some company training programs operate to indoctrinate a young engineer into engineering procedures and acquaint him with company policies.

Recently two talks were delivered which dealt with the question of what the graduate himself should do toward his professional development. At the annual dinner of the Engineers' Council for Professional Development, Eugene W. O'Brien, vice-president, W. R. C. Smith Publishing Company, and a Fellow and past-president of ASME, spoke on the subject, "What Junior Engineers Find Important." Warren M. Rohsenow, Jun. ASME, assistant professor of mechanical engineering, Massachusetts Institute of Technology, spoke on the topic, "The Role and Obligations of the Young Engineer," at the Members and Students Luncheon, Nov. 29, 1951, during the 1951 ASME Annual Meeting, Atlantic City, N. J.

Mr. O'Brien felt that commencement is a more serious break for young engineers than most of us realize. For a great many this is the first break, suddenly and boldly, from home and school influences which had long guided them. In most cases they find themselves "on their own" for the first time, and often they are amazed to find that business and professional life is so different from college life. Because Mr. O'Brien's professional activity brings him in contact with many junior engineers, he has been able to engage in a study of what young engineers find important. He recorded the replies of 446 junior engineers to his general question, "Beyond the education and technical knowledge implied by your college degree, and being of high integrity, what factor, what ability, what influence, what advice, what procedure has been most helpful to your success and progress?" He found that he could assign these replies to certain general headings.

Aids to Engineering Success

These headings are not totally independent of each other but are distinct enough to form nine classifications as follows, listed according to frequency:

1 *People*—knowing what people think and why, and knowing how to take advantage of associating with them. This also involves working in harmony with people on the same level, on the level above, and, most important, on the level below.

2 *Personality*—includes a multitude of favorable personal characteristics—principally, being gentlemanly, tolerant, and socially, professionally, and civically responsible.

3 *Articulateness*—the ability to express ideas, plans, and objectives clearly and quickly.

4 *Friendships*—actually an ingredient in many of the other classifications yet taken as a grouping itself when considering the many difficult steps which might have been made easier through guidance of one or more friends.

5 *Basic Fundamentals*—keeping your feet on the ground technically and professionally. This involves the straightforward use of laws and facts and the keeping of basic notes and records.

6 *Practical Experience*—developing judgment and professional familiarity which makes a man economically productive.

7 *Self-Analysis*—a study by the young engineer of himself, of his abilities, of his interests, of his strong and weak points, and what he has to offer as an individual, as a citizen, and as an engineer.

8 *Planned Objectives*—the determination from which the greatest achievement satisfaction will be derived, whether it be job completion, money accumulation, or service.

9 *Loyalty to the Job*—that concentration which makes the most out of the present job while looking ahead to the job of the future and planning to serve it promptly and effectively when the opportunity develops.

Mr. O'Brien believes that this advice will be more readily acceptable to young engineers because it comes from men in the same general age group. The individuals who answered the inquiry spoke informally, without inhibition, and on the spur of the moment, of the significant values necessary to build a place for themselves in professional life. The basis for this building is generally the same. How a young engineer progresses to the top is up to himself.

Job Satisfaction

While Mr. O'Brien mentioned the individual factors which junior engineers found necessary to advance professionally, Professor Rohsenow directed a great many of these qualities into the specific pattern of achievement listed as job satisfaction. He also found that the transition from student to practicing engineer was a difficult one. While the school organization was run for him, the industrial organization is run for itself and the graduate must carve out his career by initiating and executing his own program of self-improvement.

To attain a place in his profession the graduate must start at the bottom and advance within his particular organization and profession. To merit any type of advancement the young engineer must show promise of being able to accomplish successfully the work presently being done by his superiors. He should therefore examine the qualities exhibited by the men filling various top-level positions in his organization.

Professor Rohsenow hypothetically followed the chart of a research and development division down to the place the young man will take when he enters the organization. The chief engineer at the head of the organization is in charge of all engineering activities. Next, the man in charge of development and research might have under him a chief of development and a chief of research. Under these, in turn, would probably be section leaders who would each be in charge of a different phase of engineering such as heat transfer, stress analysis, machine design, and the like. Each group leader would have any number of men working for him. This is the group that the young engineer would most likely join.

All these men have responsible positions and must have certain qualities to warrant their trust. The group leader must have a wide knowledge of the problems normally encountered in his particular phase of the work. He must have the ability to get along with people—not only the members of his own group, but also the other group leaders and his immediate superior. He must be capable of exercising sound judgment in placing the proper emphasis on the jobs which his group undertakes.

The requirements for the chiefs of the development and research divisions are similar to those for the group leader but broader in scope. In order for a group leader to advance to this position he must not only be familiar with the requirements of his own work but must also have acquired a broad knowledge of the work of all the other groups which make up his division. His knowledge and exercise of judgment is projected on a much broader scale. He must have the ability to give attention to detail and also have the ability to delegate work and authority to his

[1] Design Engineer, Celanese Corporation of America, New York, N. Y. Jun. ASME.

assistants. These characteristics must be extrapolated on up through the chief engineer to the president of the organization.

The young engineer must learn first the requirements common to all these jobs in order to make the eventual progress from technician in a group to a professional engineer or group leader. His first few jobs will not be very important ones. His group leader is more than likely trying to find out how well he can perform an assigned task. It is important that any task assigned be performed with speed and precision no matter how menial it may seem to be. Even as a good technician an uninteresting job may be assigned him in order to expedite the work of the group. The duties of the young engineer are to keep his supervisor informed regarding the progress of his work and answer inquiries without becoming a "yes" man. He must be able to get along with his associates in the group and be able to present his ideas effectively in writing as well as orally. He should expand his own knowledge through additional schooling or individual study.

Outside of the attention necessary to successful completion of the young engineer's immediate job, it is vital to his professional maturity that he associate with engineers of other companies for the purpose of sharing opinions and knowledge. This is conveniently accomplished by active participation in the activities of the professional societies.

Through participation in the preparation or discussion of various technical papers, as well as in the general fellowship, the young engineer increases his knowledge besides letting others know about his activities. By enlarging his scope he stands a better chance of having his employer choose him to fill a position of responsibility.

Most important, the recently graduated engineer should remember that his degree in engineering does not make him a professional engineer. He has to acquire much experience in applying the laws of science to the solution of engineering problems and developing his ability to exercise mature judgment. In order to acquire these attributes it is necessary for him to develop a vigorous program of self-improvement both during and after his working hours. His reward for this extra effort, beside personal satisfaction, is advancement within the company and within his profession.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or not, and is operated on a nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th Street	84 East Randolph Street	100 Farnsworth Ave.	57 Post Street

Men Available[1]

Mechanical Engineer, 31, BSME, married. One year aircraft-engine test, one year design and development low-temperature pumps; three and a half years ball- and roller-bearing application engineering. Qualified for projects engineer, group leader, or section leader. Locate anywhere. Available immediately; now employed. Me-865.

Mechanical Engineer, 31, married, experienced machine manufacturing and product development. Available for responsible position in medium-size mechanical-equipment manufacturing organization, with long-term possibilities. Will consider any location. ME-866.

Mechanical Engineer, 28, BS engineering, MS industrial relations; five years industrial experience including two in methods engineering; 1½ years teaching industrial engineering. Desires college position in industrial engineering or personnel administration. Me-867.

Positions Available

Sales Engineer, recent graduate, to train for sales career with national manufacturer of conveyers, pneumatic dispatch tubes, and industrial blowers. Training will include factory program in upstate N. Y. and layout drafting and estimating on sales proposals for a period of one or two years in Md. Y6142.

[1] All men listed hold some form of ASME membership.

Sales Engineers, mechanical and electrical, for field and factory sales-engineering positions for nationally known manufacturer of leading product selling to original equipment-machinery builders. District managerships available. Salary open, plus incentive plan. Wis. Y6410.

Sales Engineer, mechanical graduate, some experience and background in cutting tools, for territory in northern N. J. Should live in the territory. $7500, drawing account against commissions. Y6420.

Mechanical Engineer, with experience in engineering department of television manufacturer. Should be familiar with mechanical components of chassis, etc. $5000 and up. New York, N. Y. Y6433.

Plant Manager, mechanical graduate, for a chemical-manufacturing division. Must be thoroughly familiar with process-type production. $20,000–$25,000. Ill. Y6434.

Estimator, at least ten years methods, cost engineering, and preparation of estimates covering light machining operations to methodize components for instrument manufacturer and prepare accurate cost estimates. $8000. Brooklyn, N. Y. Y6435.

Boilerhouse Operating Engineer, 35–60, mechanical graduate, at least five years' operating experience; water, sewage, compressed air, gas, etc., systems helpful. Will assist in directing the operation of all the utilities operations. $5400–$7200. N. Y. State. Y6440.

Engineers. (*a*) Chief engineer, over 40, mechanical or metallurgical graduate, administrative, design, construction, and plant-engineering experience in metallurgical-furnace field and mill construction. $15,000. (*b*) Assistant project engineer, mechanical or civil-engineering graduate, at least ten years' process-plant construction experience, to supervise field co-ordination covering mill construction. $10,000. Western N. Y. State. Y6446.

Mechanical Engineer, 28–32, general machine-shop experience, including tooling, forming, and die design for plastic fabricator of acetate and vinyl sheeting products. $5000–$6000. Newark, N. J. area. Y6481.

Production Manager, under 50, to assist works manager and take charge of industrial engineering including time study, wage standards, production methods, tool engineering, tool design, etc., for electromechanical instrument manufacturer. $15,000. Newark, N. J. area. Y6483.

Sales-Service Engineer, young, industrial plant-maintenance experience on instruments and controls. Must have car. $3600–$4800 plus percentage. Northern N. J. Y6492.

Mechanical Engineers, not over 45, BS degree, or equivalent in practical experience in mechanical engineering. (*a*) Mechanical engineer, at least three years' experience in preparation of designs, estimates, and specifications for machinery of various types. $6325. (*b*) Mechanical engineer, minimum of one year's experience. Must have at least general experience in machine and machinery design. $5256. Free transportation for employee and family and moving expenses. Must be American citizens. Panama. Y6500.

Chief Engineer for company engaged in precision casting. Should have considerable experience in the die-casting field and be responsible for process and plant engineering. $10,000–$12,000. Ohio. Y6503.

Mechanical or Industrial Engineer, young, one to three years' experience in time studies and methods for motor manufacturer. $4200–$5400. Northern N. J. Y6504.

Mechanical Engineers. (*a*) Senior project engineer, mechanical graduate, for development and administrative work. Should have five to ten years' experience on mechanical and electromechanical devices. Will direct subordinate engineers in this work. $5760, depending upon experience. (*b*) Project engineers, 2, mechanical graduates, to work under senior project engineers. Should have five years' experience as above. $5088. (*c*) Research trainee, graduate mechanical, good academic standing, and an interest in research for research and development on mechanical and electromechanical devices. $3324. Regular increments. (*d*) Machine designer, four years' experience, to work with research group on mechanical and electromechanical devices. $4805, Brooklyn, N. Y. Y6505.

Assistant Editor, 26–30, to prepare and edit articles covering machining operations, metal-working, and fabrication of manufactured products. $4200–$4800. New York, N. Y. Y6507.

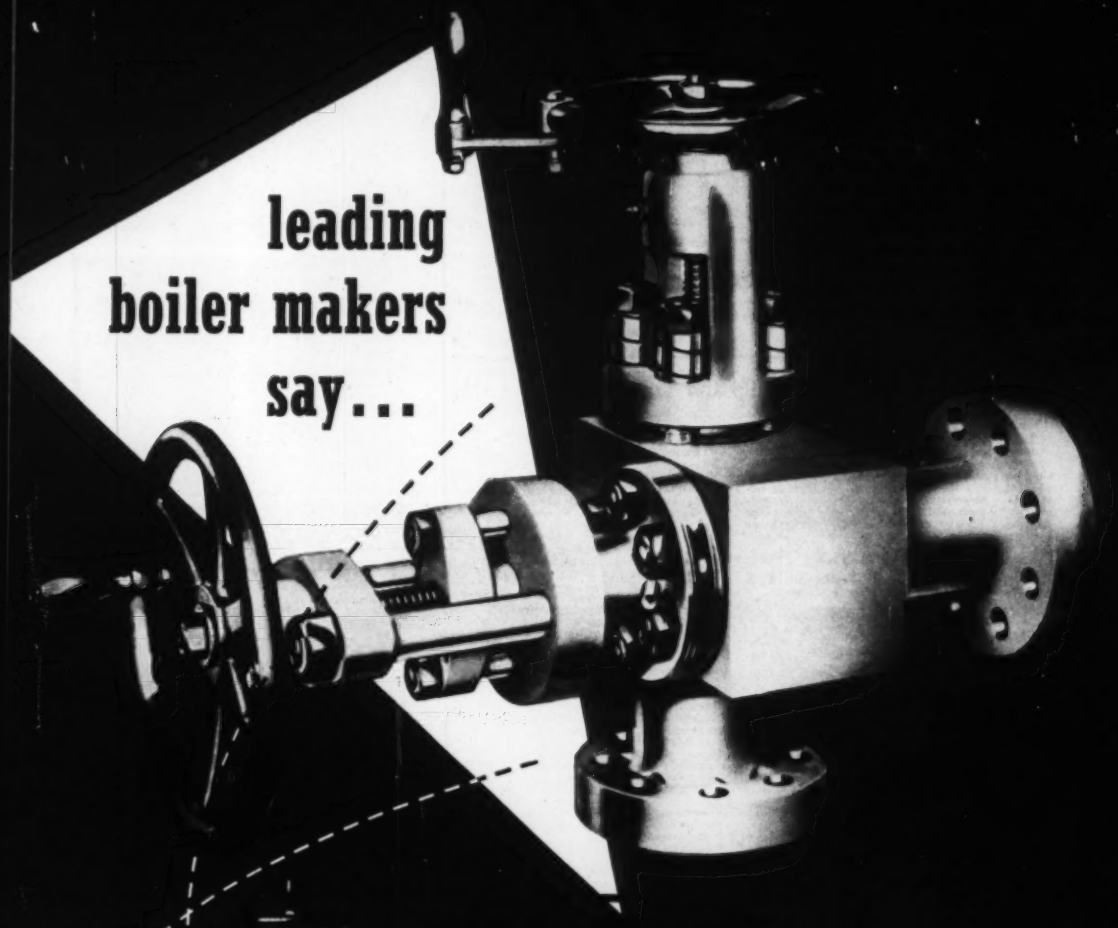
Engineers. (*a*) Chief mechanical engineer, graduate, 20 years' experience, at least five years' recent experience in installation or operation and maintenance of large rotating mechanical equipment. Complete supervision of comprehensive maintenance of large program for all large mechanical equipment, including supervison of large central machine shop, central instrument laboratory, small metallurgical laboratory, welding, etc., on large axial-flow compressors. Up to $9000. (*c*) Assistant to chief mechanical engineer, graduate or equivalent, with ten years' experience, at least two of which have been on installation or operation and maintenance of large rotating equipment. Will be responsible for development of preventive-maintenance progress on all large mechanical equipment in the engine test facility, including compressors, large speed gears, large air valves, action to be taken on lubrication and examination of parts. Able to determine causes of mechanical failures and failure to suggest remedies in design, etc. Up to $8000. Tenn. T8467.

Methods Engineer, mechanical, up to 50, five or more years' experience in methods work in machine tools and machine shop. Duties will include methods and production work on machine tools, plant layout, and some production tools, jigs, and fixtures. Company will pay fee and moving expenses. $10,000. New York, N. Y. T8495.

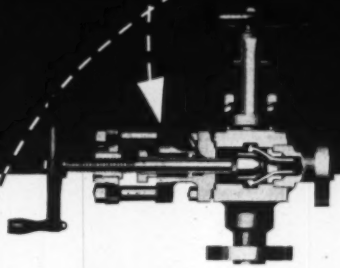
Tool Engineer, mechanical, to 45, two or more years' experience in tool and die tryout and checking. Knowledge of sheet-metal fabrication. Duties will include 30 per cent of time on the board assisting tool and die designers and 70 per cent of time in tryout and follow-up. Company

(*ASME News continued on page 182*)

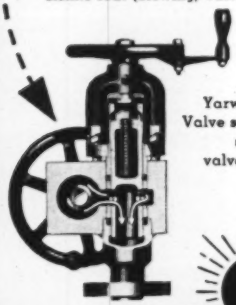
leading boiler makers say...



BLOW-OFF VALVES



Yarway Unit Tandem Valve sectioned through stellite-seat (blowing) valve. Open position.



Yarway Unit Tandem Valve sectioned through seatless (sealing) valve. Open position.

Leading steam boiler makers (names on request) standardize on Yarway Blow-Off Valves . . . for the same reasons that over 15,000 plants use them:

- UNIQUE DESIGN
- MODERN METALLURGY
- RUGGED CONSTRUCTION

} TROUBLE-FREE SERVICE

How these features will help your boiler operation is clearly explained in Yarway Blow-Off Valve Bulletins. Write for one, telling us your operating pressures.

YARNALL-WARING COMPANY 108 Mermaid Ave., Philadelphia 18, Pa.
Branch Offices in Principal Cities

BLOW-DOWN TROUBLES...KEEP BOILERS ON THE GO

will pay moving expenses and fee. $6000. Wis. T8514(b).

Maintenance Superintendent, mechanical engineer, 38–45, five year's experience in plant maintenance and building construction in machine-tool manufacturing company. Knowledge of maintenance of machine tools. Will supervise plant maintenance for plant of 2300 employees making bottling equipment and sheet-metal products. Employer will pay fee. $9000 and overtime. Ill. R8484(a).

Combustion Engineer, mechanical or other engineering degree, 35–45, at least five years' experience in combustion coal, fuel, oil or gas usage, and cost reduction. Knowledge of processing plants helpful. Will work on development and usage of combustion equipment to reduce fuel costs for multiple-plant company. Should be well versed in ventilating and dust-collecting systems. Company will pay fee. Up to $8400. Travel 20 per cent of time. Ill. R8494.

Project Engineer, up to 45, two years' experience fabricating and stamping sheet metal. Knowledge of tools and dies. Will follow sheet-metal projects from conception through production. Company will pay fee. $6000–$9000. Ill. R8499.

Designer-Estimator, 28–50, mechanical engineer, at least two years' experience designing pressure vessels to ASME Code. Knowledge of design and estimating. Will design, estimate, and have partial supervision of sheet-metal fabrication of pressure vessels. Company will help on fee. Up to $9000. Ill. R8516.

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after Feb. 25, 1952, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Member, Associate, or Junior

AHMED, M. WAHEEDUDDIN, Los Angeles, Calif.
AHUJA, PRITHVI R., Amritsar, India
ALICKOS, GEORGE, Brooklyn, N. Y.
ANDERSON, C. A., Coffeyville, Kan.
ARENS, MOSES, New York, N. Y.
BALDWIN, ALVIN J., Westfield, N. Y., (Rt & T)
BARDES, WILLIAM D., Latrobe, Pa.
BLAKER, ROBERT U., Alliance, Ohio
BORDEN, FRANK P., Maplewood, N. J.
BUSH, C. HAROLD, Muncie, Ind.
CAMPBELL, GLENN H., Newark, N. J.
CARNIE, ALEXANDER, Massillon, Ohio
CHENAULT, WILLIAM H., Atlanta, Ga.
CLARKE, LOUIS C., New Haven, Conn.
COMBS, A. BRYAN, JR., Brevard, N. C.
CONNELL, FRANK A., Chatham, N. J.
COVERT, WILLIAM V., Indianapolis, Ind.
COWLES, H. R., Fergus Falls, Minn.
CRISBY, FRANKLIN E., Driftwood, Pa.
DAS, RANENDRA N., Calcutta, India
DAVIS, CHARLES K., JR., Wilmington, Del.
DILLON, WENDELL M., North Andover, Mass.
DORRIS, GEORGE P., Webster Groves, Mo.
DREW, EVERETT G., Portland, Ore.
EDWARDS, J. C., Jr., Atlanta, Ga.
ELDRED, C. P., Winchester, Mass.
ENGLUND, JOHN E., Pleasantville, N. Y.
ERB, HARRY A., Greensburg, Pa.
FENYES, IVAN, Caracas, Venezuela, S. A.
FICKES, DONALD A., Euclid, Ohio
FISHLEIGH, CLARENCE T., Chicago, Ill.
FLINT, JAMES A., Columbus, Ohio
FLOYD, EDWIN C., Walnut Creek, Calif., (Rt & T)
FRANKEL, RICHARD S., Homestead, Pa.
GEBET, EDWARD, Brooklyn, N. Y.
GEBET, LAWRENCE, Brooklyn, N. Y.
GLENN, THOMAS H., JR., Arlington, Va.
GRAHAM, RICHARD M., Detroit, Mich.
GURGANIOUS, JOSEPH T., Phoebus, Va.
GURNEY, GORDON T., Worcester, Mass.
HARDING, G. M., Montreal, Que., Can.
HARTUNG, EDWIN W., New York, N. Y., (Rt & T)
HAWKINS, HERMAN B., Richmond, Va. (Rt)
HERRIG, L. JOSEPH, Dovey, Ohio
HOERNER, JAMES A., Hamilton, Ohio
HOPKINS, BRYANT L., JR., Waterville, Me.
HOUTZ, JOHN E., JR., Baltimore, Md.
JACKOVITZ, JOSEPH J., Allentown, Pa.
JORDAN, LYTLE A., Cincinnati, Ohio
KAMEYAMA, T., Amagasaki, Hyogo-ken, Japan
KENERSON, ROBERT K., Kansas City, Mo.
KERN, WILLIAM R., Gwinhurst, Wilmington, Del.
KISLING, JACK DE F., Hillside, N. J.
KNAPP, WILLIAM H., Meadowbrook, Pa.
KNIGHT, ELLIOTT P., Boston, Mass.
KRUEGER, ROBERT S., East Hampton, Conn.
LANGFORD, HENRY L., Liberty, Texas
LEGEZA, THOMAS B., Chicago, Ill.
LUTES, HENRY M., Louisville, Ky.
MAJOR, THOMAS E., Peninsula, Ohio
MAVRIKS, GEORGE L., Jackson Heights, L. I., N. Y.
McDONALD, NEAL B., San Francisco, Calif.
MIKUS, CLIFFORD A., Verona, Pa.
MORGAN, COMMODORE P., Springfield, Mo.
MORGAN, EDWARD L., Hyattsville, Md.
NEWSOME, DONALD W., Salt Lake City, Utah
O'DONNELL, C. J., West Haven, Conn.
ONDERKO, WALTER E., Roslyn, Pa.
PANTANO, MICHAEL A., Phoenix, Ariz.
PAULSON, OWEN D., Seattle, Wash.
POMPER, ANTHONY W., New Market, N. J.
PRESTON, JOHN J., Baltimore, Md.
RAJAGOPAL, A. R., Sindri, Bihar, India
RAO, DHARAPURAM R. K., Saurastra, India
ROBERTS, R. E., Findlay, Ohio
ROBITSCHEK, EMMERICH, New York, N. Y.
RYGELIS, JOSEPH, Brooklyn, N. Y.
SAMUELIAN, RICHARD W., Fresno, Calif.
SANCHEZ, A. SANCHEZ, Bogatá, Colombia, S. A.
SCHANTZ, ROBERT M., Bryn Mawr, Pa.
SCHEURICH, JOSEPH M., Oak Park, Ill.
SCHROCK, VIRGIL E., El Cerrito, Calif.
SHALLENBERGER, CLARENCE D., JR., El Dorado, Ark.
SHAVER, GLENN J., Kansas City, Mo.
SHEPSTONE, OSCAR, Pittsburgh, Pa.
SHERBROOKE, WALTER A., New York, N. Y.
SMITH, HALSEY F., Los Angeles, Calif.
SMITH, HAROLD B., Boston, Mass.
SPREDS, JOHN A., Alliance, Ohio
SPRIDEN, EDGAR F., Parkersburg, W. Va.
STACK, RICHARD O., Milwaukee, Wis.
STEIN, NORMAN N., Altadena, Calif.
STOCKWELL, E. E., Baton Rouge, La.
SUEZ, ROBERT KYEU-WO, Singapore, Strait Settlement, Malaya
SWEENEY, JAMES C., Oak Park, Ill.
TANNEHILL, RICHARD L., Connersville, Ind.
THAYER, WILLIAM W., Tulsa, Okla.
TREADWAY, HOWARD W., Plainfield, N. J.
TRIPP, DAVID A., New York, N. Y.
TRUSCOTT, HARRY A., Cincinnati, Ohio
TSAO, T. C., New York, N. Y.
VESILIND, PAUL E., Beaver, Pa.
VICKERY, STEWART R., Baltimore, Md.
WAINRIB, JULES, Alliance, Ohio
WANSON, LEON J., Anderghem, Brussels, Belgium
WHINERY, RICHARD E., Indianapolis, Ind.
WHITTLESEY, JAMES W., Bellflower, Calif.
WILSON, C. KENNETH, Long Island City, N. Y.
WINE, LEONARD J., Detroit, Mich.
WISEMAN, DALE, Columbus, Ohio
WRIGHT, GEORGE B., Latrobe, Pa.
VAZBECK, JOSEPH A., Shreveport, La.
YU, YI-KUAN, St. Louis, Mo.

CHANGE IN GRADING

Transfers to Member and Associate

HABCOCK, STANLEY E., Canfield, Ohio
BARTLETT, ROBERT L., Istanbul, Turkey
BUNTING, JOHN T., Pittsburgh, Pa.
CHOU, JAMES C. S., Maui, Hawaii, T. H.
CLARKE, C. EDWIN, Sparrows Point, Md.
COLBY, CLARENCE E., Nahant, Mass.
COOLEDGE, MARSHALL M., New York, N. Y.
DE VILBISS, THOMAS A., Plainfield, N. J.
DUNNINGTON, FRANCIS A., Kenmore, N. Y.
ERHARD, ROBERT W., Greensburg, Pa.
FRIEND, WALTER F., New York, N. Y.
FUCHS, EDWARD A., Schenectady, N. Y.
GANNETT, WRIGHT K., Davenport, Iowa
GAWAIN, THEODORE H., Monterey, Calif.
GOULD, WILLIAM R., Long Beach, Calif.
GUERRES, RICHARD M., San Jose, Calif.
HART, D. A., Prospect Park, Pa.
HEM, EILIF S., Brooklyn, N. Y.
KING, RENO C., JR., New York, N. Y.
LARSON, JOHN A., Oakland, Calif.
LIVENGOOD, JAMES C., South Lincoln, Mass.
MATHER, ROBERT H., Woodstock, Ill.
MITCHELL, STEPHEN G., Aruba, Curaçao, N.W.I.
MONORE, PAUL H., JR., Pasadena, Calif.
REYNOLDS, REXFORD V., Greensburg, Pa.
SACKS, NEWTON N., Rock Island, Ill.
SMART, JOHN E., La Grange Park, Ill.
SPIRO, IRVING J., Sherman Oaks, Calif.
STERN, ARTHUR B., Houston, Texas
STERN, JOSEPH H., Farmingdale, N. Y.
THOMPSON, GLENN A., River Edge, N. J.

Transfers from Student Member to Junior.....115

Obituaries

William John Angus (1889–1950)

WILLIAM J. ANGUS, production superintendent, Consolidated Edison Company of New York, Inc., died Oct. 22, 1950. Born, New York, N. Y., Aug. 11, 1889. Education, attended public schools, New York, N. Y.; Hays School of Combustion Engineering. Mem. ASME, 1946. Author of technical articles on Waterside Station. Survived by wife, Helen; three children, Jean, Richard, and Ruth Ann.

Donald Stuart Barrows (1877–1951)

DONALD S. BARROWS, retired vice-president in charge of engineering and research, The Symington-Gould Corp., died Oct. 27, 1951, in Rochester, N. Y. Born, New Haven, Conn., Sept. 22, 1877. Parents, Samuel H. and Katharine D. Barrows. Education, LLB, New York Law School, 1898. Married Florence Douglas (died, 1947). Mem. ASME, 1921. Survived by a niece, Dorothea Y. Barrows, New York, N. Y.

Charles Beensen (1891–1950)

CHARLES BEENSEN, founder, B-C Pump and Engineering Co., Inc., Merritt Island, Fla., died Dec. 19, 1950. Born, Susquehanna, Pa., July 9, 1891. Parents, Charles and Adelaide (Spellerberg) Beensen. Education, BSME, Cooper Union, 1921; Hays School of Combustion Engineering, 1931. Married Julia Bailey, 1915. Assoc.-Mem. ASME, 1922; Mem. ASME, 1935. Served the Society as member, Executive Committee, Florida Section, 1942–1943. Held patent on condenser and heat-exchanger cleaning, by surface chlorination, to maintain maximum heat-transfer rate, 1934. Awarded first prize, 1938, and honorable mention, 1942, by The James F. Lincoln Foundation. Survived by wife.

A. Harold Blake (1896–1951)

A. HAROLD BLAKE, mechanical-engineering professor, University of Utah, died Oct. 29, 1951. Born, Lake City, Utah, April 3, 1896. Parents, John Joseph and Bridget (Ryan) Blake. Education, BS, University of Utah, 1920; MME, Cornell University, 1926. Married Lucile Farnsworth, 1922. Jun. ASME, 1925; Mem. ASME, 1947. He was coauthor of "Automotive Manual," 1923. Survived by wife and three sons, Robert H., William F., and John J.

Frank Busch (1896–1951)

FRANK BUSCH, mechanical engineer, Babylon, N. Y., died Oct. 23, 1951. Born, Portland, Ore., Feb. 14, 1896. Parents, Jacob and Barbara (Wirth) Busch. Education, Whitman College, 1919; ME, Stevens Institute of Technology, 1922. Married Emma Hauser, 1925. Assoc-Mem. ASME, 1932; Mem. ASME, 1935. Survived by wife and three children, Donald F., Mrs. William Burton, Amityville, L. I., and Marjory.

Joseph Howard Groom (1896–1951)

J. HOWARD GROOM, mechanical engineer, field-service department, Cincinnati Milling Machine Co., Cincinnati, Ohio, died Oct. 27, 1951. Born, Yeovil, Somersetshire, England, Feb. 29, 1896. Parents, Joseph and Frances (Willbond) Groom. Education, English grade school; 4 years, Ohio Mechanics' Institute. Naturalized U. S. citizen, Cincinnati, Ohio, 1927. Married Gertrude Davenport, 1928. He wrote several articles for technical magazines. Assoc-Mem. ASME, 1927; Mem. ASME, 1935. Survived by wife and two sons, Arthur H. and Leslie C., Viroqua, Wis.; a sister, Mrs. K. Ruoff, three brothers, William, Wewahitchka, Fla.; Sidney A., Nashville, Tenn.; Carrol J.; and four grandchildren.

Robert Wilton Hague (1898–1951)

ROBERT W. HAGUE, project engineer, service department, Tennessee Eastman Corp., Kingsport, Tenn., died Oct. 20, 1951. Born, Blue Island Ill., Aug. 22, 1898. Parents, James and Anna (Rodosky) Hague. Education, high-school graduate; 1 year, Beloit College; ICS. Married Jessie German, 1926. Mem. ASME, 1945. Survived by wife and two daughters, Bobbe Jean and Mrs. Marlyn Hague Simon.

(*ASME News continued on page 184*)

No more "off the cuff" decisions when you compare blower values

Type H, 3-Stage Centrifugal Exhauster in Mexican mine service. Capacity 15,100 cfm.

- ☐ Choice of Rotary or Centrifugal
- ☐ Capacity matched to the job
- ☐ Easy accessibility
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- ☐ Freedom from breakdowns
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If you'd like to tell us about your specific problem, we'll gladly send detailed information for comparison, or supply engineering help from our 98 years of blower building experience.

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THE *DUAL-ABILITY* LINE OF MODERN EQUIPMENT TO HANDLE GAS AND AIR

Multi-Stage Centrifugal Exhausters

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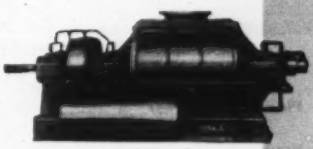
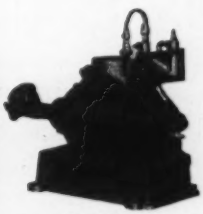


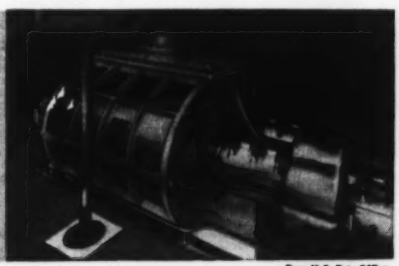
Rotary Positive Gas Pumps



Positive Displacement Motors

Inert Gas Generators

ROTARY



Type HD Gas Exhauster in cube-making plant.

Reg. U.S. Pat. Office

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BLOWER BUILDERS SINCE 1854

ONE OF THE DRESSER INDUSTRIES

George Frederick Hemmerle (1905–1951)

GEORGE F. HEMMERLE, manager, Alwood Products Co., Kulpsville, Pa., died Nov. 3, 1951, of a heart attack. Born, Philadelphia, Pa., Aug. 23, 1905. Parents, George and Louisa Hemmerle. Education, graduate, Philadelphia Trades School and The Franklin Institute. Married Regina Carton, 1924. Assoc. ASME, 1946. Survived by wife and son, Robert G.

Otto Ernst Hilmer (1885–1951)

OTTO E. HILMER, partner, Fosdick and Hilmer-Cincinnati, Ohio, died July 10, 1951, of a heart attack. Born, New York, N. Y., Oct. 16, 1885. Parents, Otto and Pauline (Vogt) Hilmer. Education, ME, Cornell University, 1907. Married Adelaide Lambert, 1912; children, Otto L., Herbert F., and Harry B. Assoc. Mem. ASME 1916; Mem. ASME, 1918.

Elmer Henry Horstman (1899–1951)

ELMER H. HORSTMAN, chief engineer, steam-turbine section, Power Division, Allis-Chalmers Manufacturing Co., died of a heart attack, Nov. 24, 1951, at North Freedom, Wis. Born, Brownstown, Ind., July 13, 1899. Parents, William and Mary (Nierman) Horstman. Education, BSME, Purdue University, 1923. Married Rosella Lieder, 1938. Jun. ASME, 1924; Mem. ASME, 1948. Survived by wife and three children, Sandra Lee, Nancy D., and William A.

Joseph Homet Kerrick (1893–1951)

JOSEPH H. KERRICK, research engineer, The Philadelphia and Reading Coal and Iron Co., Philadelphia, Pa., died during 1951, according to a letter received by the Society. Born, Towanda, Pa., Feb. 20, 1893. Parents, Emery J. and Augusta A. (Homet) Kerrick. Education, Germantown Academy; EE, Lafayette College, 1915. Married Mabel Z. Ashton, 1917; children, Ann A., and Josephine H. He wrote several articles on anthracite coal. Mem. ASME, 1940.

Carroll Knowles (1879–1951)

CARROLL KNOWLES, chief engineer, Machinery Division, Pratt and Whitney Division, Niles-Bement-Pond Co., West Hartford, Conn., died June 26, 1951. Born, Kingston, R. I., Oct. 8, 1879. Education, BS, Rhode Island State College, 1899. Mem. ASME, 1940. He held more than 30 U. S. Patents in the field of aviation. Survived by wife.

Haskell DuBose Lanier (1898–1950)

HASKELL DUB. LANIER, vice-president in charge of engineering, Vertientes-Camaguey Sugar Company of Cuba and Tanamo Sugar Company of Cuba, died April 27, 1950, at Jovellanos, Cuba. Born, Donaldsonville, La., April 12, 1898. Parents, Mr. and Mrs. James A. Lanier. Education, graduate, Napoleonville High School, 1915; 3 years, Louisiana State College, 1915–1918. Mem. ASME, 1936. Survived by four children, Mrs. Florence L. Hall, Alexandria, La.; Mrs. Kathleen L. Long, Knoxville, Tenn.; Charles M.; and James A., 2nd, both of Baton Rouge, La.

Paul Walker Latham, Jr. (1925–1951)

PAUL W. LATHAM, JR., Lieutenant, U. S. Marine Corps, was killed in action in Korea, June 19, 1951. Born, Minneapolis, Minn., June 24, 1925. Parents, Paul W. and Eunice (Spicer) Latham. Education, BE, Yale University, 1946. Married Mary Lou Garth, 1949. Jun. ASME, 1946. Episcopal Church Parish Hall to be named Latham Hall in his honor. He received the following military medals: Purple Heart, American Campaign, Victory for services during World War II, Korean Service. Survived by wife, parents, and two brothers, Allen and William D.

George Gilbert Mize (1895–1951)

GEORGE G. MIZE, chief engineer, The Diamond Chain Co., Inc., Indianapolis, Ind., died Sept. 4, 1951. Born, Elnora, Ind., Jan. 12, 1895. Parents, Lemuel and Annie E. (Canary) Mize. Education, BSME, Purdue University, 1918. Married Ruth M. Richards, 1925. He held several U. S. Patents relating to steel roller chains. Mem. ASME, 1950.

Frank Henkels Rogers (1884–1951)

FRANK H. ROGERS, retired consulting engineer, Baldwin Locomotive Works, research engineer, and author of many articles on hydraulic power, died Nov. 14, 1951, at his home in Wynnewood, Pa. Born, Philadelphia, Pa., March 26, 1884. Parents, John I. and Elizabeth H. Rogers. Education, Penn Charter School; BS, University of Pennsylvania, 1906; ME, 1911. Married Ellen Ward, 1918. He held U. S. Patents relating to hydraulic turbines. He served the Society on the committees for test codes for centrifugal pumps and speed-responsive governors. Mem. ASME, 1917; Fellow ASME, 1951. Survived by wife, two daughters, Mary Elizabeth and Mrs. Frank X. De Lone; a son, Joseph W.

Robert James Osborne Simpson (1858–1951)

ROBERT J. O. SIMPSON, retired former director L. S. Starrett Co., Athol, Mass., died Feb. 5, 1951 in the Detroit Memorial Hospital, Detroit, Mich. Born, Toronto, Ont., Can., June 9, 1868. Parents Robert and Jane (Osborne) Simpson. Education, ordinary home school. Married Dora Uhl, 1894 (died 1941). Mem. ASME, 1906.

George Hillier Smith (1888–1951)

GEORGE H. SMITH, provincial-engineering representative, William and J. G. Greey Co., Ltd., Toronto, Ont., Can., died June 4, 1951, at his home in Montreal, Que. Born, Hull, England, July 7, 1888. Education, 3 years, Hymer's College, Hull, England. Mem. ASME, 1943. Survived by wife, Lottie L. Smith.

Harold Doremus Tompkins (1888–1951)

HAROLD D. TOMPKINS, vice-president and treasurer, Smooth-On Manufacturing Co., Jersey City, N. J., died at his home in Summit, N. J., Nov. 27, 1951. Born, Jersey City, N. J. Feb. 17, 1888. Parents, Samuel D. and Gettiana (Vreeland) Tompkins. Education, ME, Cornell University, 1910. Married Katharine Tennant. Jun. ASME, 1917; Mem. ASME, 1926. Survived by wife and three daughters, Anna Van S., Mary T. Starkweather, Millinocket, Me.; and Louise.

Joseph Patrick Walsh (1887–1951)

JOSEPH P. WALSH, president, Walsh Construction Limited, Vancouver, B. C., Can., died Oct. 7, 1951. Born, North Wheeler, Mich., April 23, 1887. Education, ICS; La Salle University. Mem. ASME, 1936.

Chester Arthur Williams, Jr. (1920–1950)

CHESTER A. WILLIAMS, JR., assistant to factory supervisor, Radio Tube Division, Tung-Sol Lamp Works, Newark, N. J., died Nov. 20, 1950. Born, Brooklyn, N. Y., Feb. 6, 1920. Parents, Chester A. and Julia V. (Amlick) Williams. Education ME, Stevens Institute of Technology, 1942. Married Lucille MacBride, 1944. Jun. ASME, 1942. Survived by wife and son, Peter Steven.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult reverse side of card for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions enrollment are correct. Please check whether you wish mail sent to home or office address.

For your convenience a form for reporting your address, business connection, and Professional Divisions enrollment is printed on this page. Please use it to keep the master file up to date.

Four weeks are required to complete master-file changes.

ASME Master-File Information

(Not for use of student members)

Please print — **Check mailing address**

Name ..... (Last / First / Middle)

Home address ..... ☐ (Street / City / Zone / State)

Name of employer .....

Address of employer ..... ☐ (Street / City / Zone / State)

Product or service of company .....

Title of position held .....

Nature of work done .....

Please register me in three Professional Divisions as follows:

1 .....

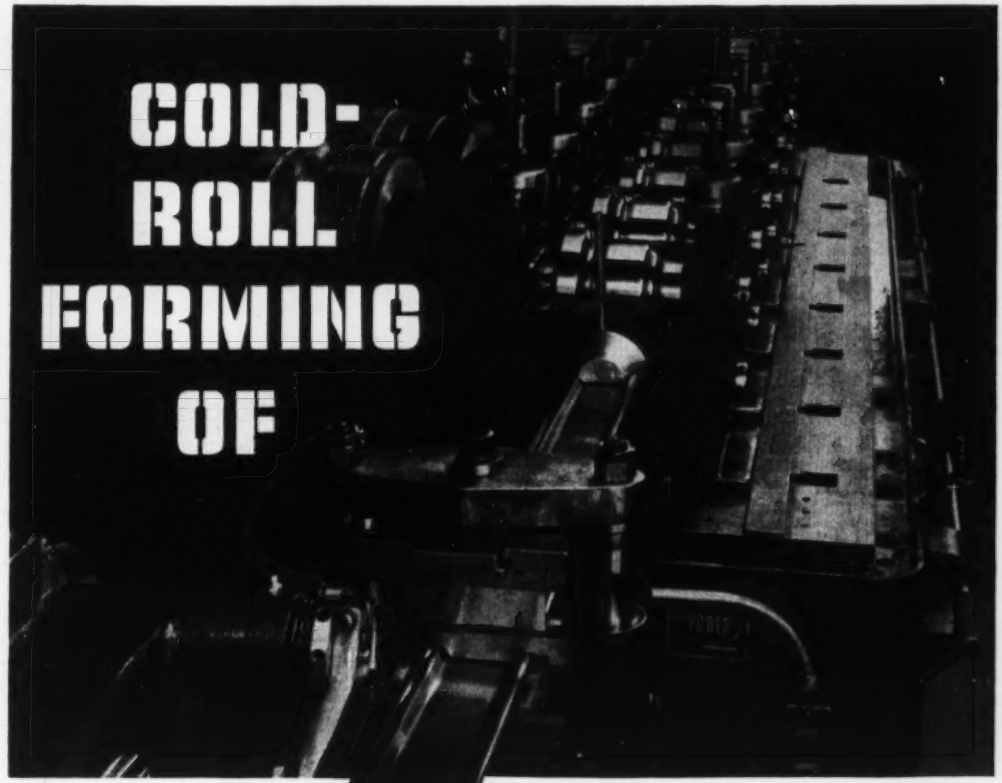
2 .....

3 .....

(Processing of address change requires four weeks)

I am a subscriber to (please check)

Transactions ☐ Journal of Applied Mechanics ☐ Applied Mechanics Reviews ☐



Pre-Coated Stock

● When roll forming is not to be followed by other operations which may damage fine finishes, it is common practice to use stock which has already been given the finish ultimately desired. Because, with proper design, roll pressures can be held extremely low, and the further fact that the metal is not heated, the process permits a wide freedom of choice in decorative and protective finishes.

Large quantities of hot dipped galvanized stock are being cold-roll formed. Electro galvanizing and plating with chromium, brass and copper most easily meet roll-forming requirements. So also metal which has been polished, burnished, buffed or similarly treated.

Roll-forming of stock which has been painted or given other organic coatings, is also practical. Better coatings are constantly being developed for this purpose.

Thickness of stock, design of profiles, kind of coating desired, and number of roll passes, are the principal factors to be taken into account.

The services of Yoder engineers are at your disposal in finding the best answer to problems of this kind. Yoder Book on Cold-Roll-Forming is yours for the asking.

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JENKINS PRACTICAL PIPING LAYOUTS

59

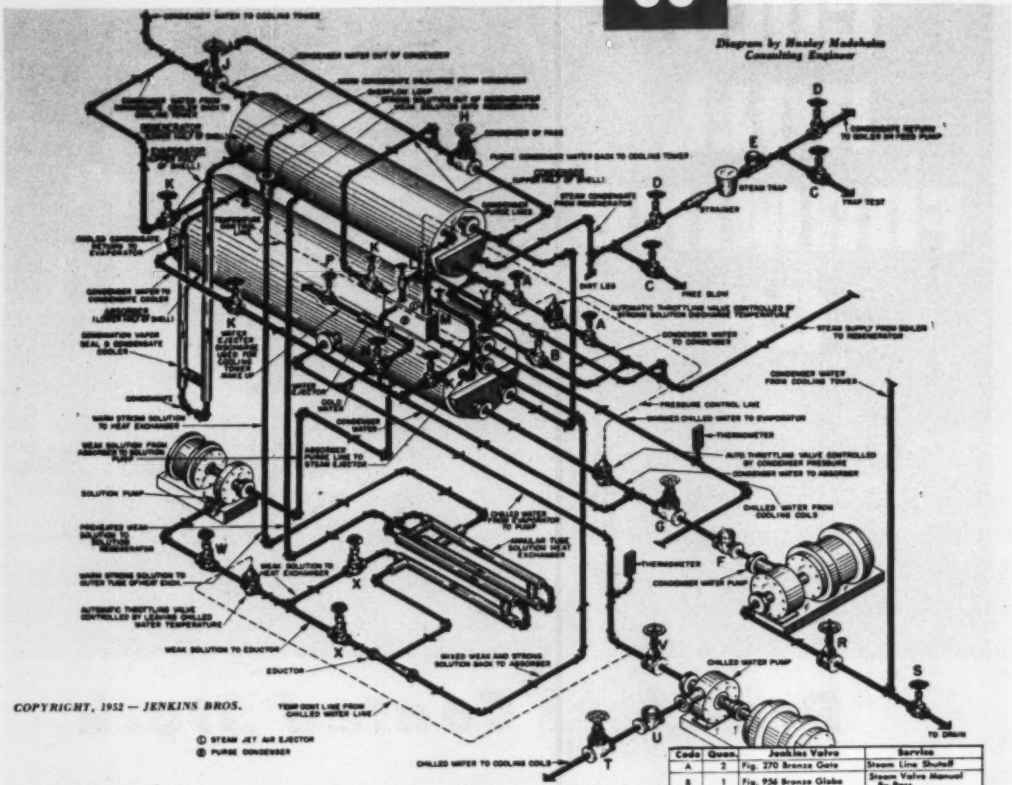

Diagram by Hunley Madeheim Consulting Engineer

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Code	Quan.	Jenkins Valve	Service
A	2	Fig. 270 Bronze Gate	Steam Line Shutoff
B	1	Fig. 926 Bronze Globe	Steam Valve Manual By-Pass
C	2	Fig. 106-A Bronze Globe	Trap Test, Free Blow
D	2	Fig. 270 Bronze Gate	Steam Condensate Shut-off
E	1	Fig. 762 Br. Swing Check	Prevent Condensate Backflow
F	1	Fig. 624 I.B.B.M. Sw. Check	Condenser Pump Discharge
G	1	Fig. 142 I.B.B.M. Globe	Condenser Pump Discharge
H	1	Fig. 142 I.B.B.M. Globe	Condenser By-Pass
J	1	Fig. 651, I.B.B.M. Gate	Condenser Discharge Shutoff
K	4	Fig. 106-A Bronze Globe	Condenser Water
L	1	Fig. 744-G, Bronze Needle	Condenser Purge Line
M	1	Fig. 743-G, Bronze Needle	Absorber Purge Line
N	1	Fig. 106-A Bronze Globe	City Water to Water Ejector
P	1	Fig. 47-U, Bronze Gate	Water Ejector Discharge
R	1	Fig. 651, I.B.B.M. Gate	Condenser Pump Suction
S	1	Fig. 106-A Bronze Globe	Condenser Water Drain Valve
T	1	Fig. 142 I.B.B.M. Globe	Chilled Water Pump Discharge
U	1	Fig. 624, I.B.B.M. Sw. Check	Chilled Water Pump Discharge
V	1	Fig. 651, I.B.B.M. Gate	Chilled Water Pump Suction
W	1	Fig. 75-A All Iron Globe	Solution Flow Control
X	2	Fig. 75-A All Iron Globe	Solution Flow Control
Y	1	Fig. 926, Bronze Globe	Steam Ejector Shutoff

VALVE RECOMMENDATIONS For details of valves to suit varying conditions, see Jenkins Catalog.

How to plan ABSORPTION REFRIGERATION CONNECTIONS FOR AIR CONDITIONING

Absorption refrigeration systems for air conditioning generally use water as the refrigerant and a water absorbent salt solution which dissolves the vapor from the chilled water in the evaporator, with a very low pressure and temperature resulting. The chilled water is then pumped through coils of the air handling units.

The diluted salt solution is withdrawn from the absorber. A portion is pumped to an eductor, the remainder to the solution regenerated through an annular tube heat exchanger. In the regenerator, the weak solution is heated by a steam coil to boil off the water vapor dissolved in the absorber. This strengthened solution then returns to the absorber through the heat exchanger and eductor.

The steam boiled off the weak solution is condensed and returned to the evaporator pan through the vapor seal loop. Tandem steam and water jets maintain low pressure in both shells. Cold water from the water jet is used for makeup in the cooling tower.

Consultation with piping engineers is recommended when planning any major piping installations.

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering, select all the valves you need from Jenkins complete line. It's your best assurance of *lowest cost in the long run.* Jenkins Bros., 100 Park Ave., New York 17; Jenkins Bros., Ltd., Montreal.

COMPLETE DESCRIPTION AND ENLARGED DIAGRAM OF THIS LAYOUT FREE ON REQUEST. Includes additional detailed information. Ask for Piping Layout No. 59.

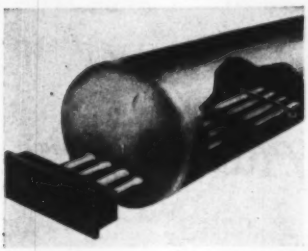
Keep Informed

New Equipment

Tubular Heaters

A complete line of tubular heaters that provide low density electric heat for oils, tars, resins, and other viscous fluids has been announced by the Hynes Div. of the Martin-Quaid Co., Philadelphia, Pa.

The tubular heater differs from so-called "immersion heaters" in that the design permits large input capacity without exceeding critical heat density limitations of the fluid being heated. Previous problems in electric heating such as carbonization and other forms of fluid breakdown resulting from local overheating are eliminated.



By using various combinations of tube and element assemblies, the tubular heaters can be provided to fulfill most requirements, as to total input capacity, heat density, and conforming to the physical requirements of the tank or vessel. These heaters are installed without liquid joints and the internal heating elements can be removed from the tube enclosures at any time without draining fluid from the vessel. Because of their construction, the heaters are practically immune to mechanical damage and readily available in moisture or explosionproof models.

Oxy-Argon Mixture

A new principle that multiplies the speed of sigma welding of stainless and carbon steels has been announced by Linde Air Products Co., a Division of Union Carbide and Carbon Corp., New York, N. Y. Unusual results have been obtained by use of a mixture of oxygen in argon as a shielding atmosphere.

Research has established that, for best welding conditions, metal transfer consists of a series of discrete metal droplets propelled at a high velocity. Droplet formation will vary with different metals and for different current densities.

Recent investigations by Linde have shown that the droplet rate, particularly on stainless and carbon steels, can be materially increased by the addition of small percentages of oxygen to highly purified argon. Droplet rate in this oxy-argon mixture has been as much as 50 times greater than in an atmosphere of pure argon, other conditions being the same.

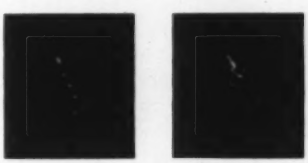
This greatly increased droplet rate, with no change in current density, permits welding at higher speeds without undercutting. Coalescence of the weld metal is improved at increased welding speeds. Overhead welding of stainless steel is made practicable.

On the other hand, the oxy-argon mixture permits welding at lower current densities. This means that larger diameter, more economical rods may be used for a given welding current. If the same size rod now available is used, then thinner materials can be welded.

Use of this special argon is expected to expand the application of sigma welding on stainless steel because of improved economy, and ability to perform welding operations not practicable with straight argon. Likewise, on carbon steels, increased applications of sigma welding can be expected as welding speeds can be at least doubled, gas consumption correspondingly reduced, and less expensive welding rod used.

The oxygen-argon mixture has been introduced on the market as Linde argon-sigma grade. Its price will be the same as for Linde argon, standard welding grade.

In the accompanying illustration the drawing on the left shows the sigma welding arc with Linde argon, sigma grade, while the drawing on the right simulates the arc in an atmosphere of pure argon. The conditions illustrated are for identical current densities and welding rod sizes.



The relative size of the drop of metal being transferred in each case shows that many more, but smaller, drops are formed in the special grade argon atmosphere, thus adding greatly to the inherent stability of the arc under all conditions. During the time of a full cycle of droplet formation in a pure argon atmosphere (right drawing), some 50 droplets will have been deposited in the special grade argon atmosphere (left drawing). Also illustrated is the fact that the weld bead is generally wider and flatter in the special gas atmosphere than the narrower and higher bead in the pure argon atmosphere.

Pressure Gage

A Vibrotron pressure gage, the first in a series of transducers developed to fill the need for a miniature electronic pressure-sensitive pickup with variable frequency output, has been announced by Byron Jackson Co., Los Angeles, Calif. This unit is especially designed for use in aircraft and missile flight tests. The Vibrotron type of gage has excellent stability and an exceptionally high order of resolution.

A Model PM-14 pressure gage and a Model D-1 Oscillator are shown in the accompanying picture. The gage, which may be mounted remotely from the oscillator, controls the operating frequency of the oscillator. A change in pressure at the gage produces a corresponding change in the frequency of the oscillator. The oscillator frequency can be measured by suitable frequency counting equipment.

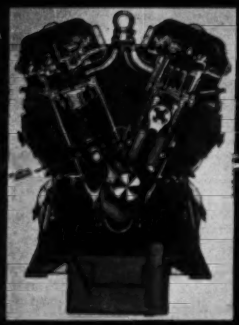
The pressure gage is $^9/_{16}$ in. in diam and $2^1/_2$ in. long. The oscillator is 4 in. $\times$ $4^1/_4$ in. $\times$ 1 in. thick.

Both the gage and the oscillator operate in temperatures ranging from -70 F to 250 F. The gage alone will operate up to 400 F with special construction.

Radiation Monitor

A new instrument that detects and records dangerous gamma radiations in an area and sounds an alarm when average tolerance limits are exceeded has been announced by the Meter and Instrument Department of the General Electric Co.

Called an "area health monitor," the device provides instantaneous indication of radiation, total radiation received in any preset period, and a 30-day integrated record of the radiation present in the immediate vicinity of the detector in 15-min intervals. It also contains a means of telemetering the rate of radiation to remotely located indicating stations.



In diesel-electric locomotives, Silastic gaskets for cylinder liners, water ports and oil pans, eliminate major overhauls previously caused by premature failure of organic rubber seals.

Heating elements embedded in Silastic are used to prevent icing of air intake doors on jet engines.

In spite of hot oil and long exposure to temperatures ranging from below zero to 400-450 F., Silastic spark plug boots exclude moisture, make automobile engines easy to start on wet mornings.

Silastic* works where ordinary rubber fails

At temperatures from −100° to over 500° F.,
in contact with hot oil at 350-400° F.,
in spite of weather, corona, shock and vibration,
you can count on Silastic to maintain a tight seal
or to confine electricity at high or low voltages.
That's proved by the fact that Silastic is used
to insulate traction motors, Navy control cable and
ignition cable for aircraft and ordnance vehicles.
It's used to seal heating and deicing systems,
bomb bay doors, limit control switches
and rocker box covers on aircraft;
sole plates in domestic steam irons;
cylinder liners and water ports in
diesel-electric locomotive engines.

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*T.M. Reg. U.S. Pat. Off.

In operation, the area health monitor measures and records the gamma—or x-ray's ionizing potential—the important factor in determining the effect that radiation will have on human tissue.

Its range is $^1/_2$ to 5 times tolerance (tolerance is 6.25 milliroentgens per hour), with an over-all plus or minus accuracy of 10 per cent. Operation is on a power supply of 60 cycles, 115 volts.

Additional information on the new Area Health Monitor is given in publication GEC-827, available from General Electric Co., Schenectady 5, N. Y.

Noise Analyzer

The Type 1550-A Octave-Band Noise Analyzer as announced by General Radio Co., Cambridge, Mass., is particularly useful in applications where reasonably continuous spectrum noises are found and great detail in the analysis is not required. It has been used successfully for determinations of loudness, speech-interference level, articulation index, airplane comfort level, and in other problems involving the reduction of noise to produce comfort or ear protection. The octave-band analyzer can also be used in the determination of the sound-transmission loss of building walls, partitions, and floors; and is useful as a selective bridge, detector or filter.

Eight pass bands are provided; the lowest is a low-pass filter and the highest a high-pass filter; the middle six, covering from 75–4800 cycles, are each an octave in width. The initial rate of attenuation beyond cut-off of the band pass sections is about 50 decibels per octave.

An amplifier, calibrated attenuator, and indicating meter in the instrument make it possible to measure octave-band levels over a range of about 60 decibels. A level control is provided to set the gain of the amplifier, with input levels between 1 and 10 volts.

The octave-band analyzer is designed to operate from the output of a standard sound-level meter, such as the General Radio Type 1551-A and Type 759-B Sound-Level Meter. For levels above 70 db, it can be operated directly from a microphone.

New Verson Press Brake

What is believed to be the first press brake ever to utilize photoelectric control of the "ram" motion has been constructed by the Verson Allsteel Press Co. of Chicago, Ill.

Through use of the General Electric electronic system, the ram may be held completely level through its stroke, or may be operated at a preselected degree of tilt down to a thousandth of an inch.

The new press brake is hydraulically operated. The ram is actuated by two independent hydraulic cylinders supplied

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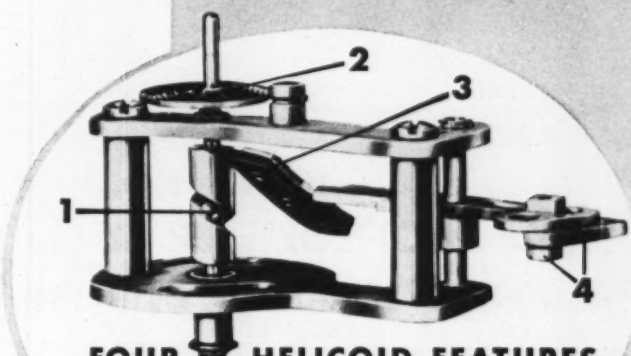
The gage that retains its original accuracy longer, lasts longer, costs less per gage, per year

The greatest achievement of the gage makers' craft—pressure gages without gears. The Helicoid movement... tested and proved in years of hard service... is a simple cam and roller arrangement that gives long, trouble-free service.



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3. Long Life Cam (no gear teeth)
4. Hardened Monel link and screws

• HELICOID GAGES, which do not have gear teeth to wear out, are made in a full range of pressures... in various sizes and shapes, with black, white and radiant faces. For wall or stem mounting, flush or panel mounting, or flangeless. No finer gages are made. Helicoid Gages cost less in the long run.

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MEASURE IN MICROINCHES RMS

What Does Belong— in this Picture?

...the PROFILOMETER at the NORTON SCHOOL OF GRINDING

Shown above is a customer group attending the school of grinding of the Norton Company, Worcester, Massachusetts. Here the latest grinding machine developments are explained to representatives of a number of the country's leading industrial firms.

One piece of equipment appears in this picture . . . the Profilometer. Obviously, in a discussion of modern grinding techniques, an accurate knowledge of the surface finishes that are secured is of primary importance. Norton Company recognizes the Profilometer as the instrument which does provide dependable roughness ratings in microinches RMS—the accepted standard of measurement throughout industry. For that reason, the Profilometer *does* belong in this picture—and on this conference table.

To the men who attend these sessions, the value of the Profilometer increases immeasurably when they put it to everyday use in the production departments of their own plants. There it becomes a part of routine grinding and other machining procedure . . . a means to secure exactly, quickly and easily the information desired on surface finishes. That is why you find it "in the picture" in their companies and wherever quality control is a consideration.

To learn how the Profilometer can help cut costs in your production, write today for these free bulletins.

Profilometer is a registered trade name.

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from separate matched pumps. A reversible booster hydraulic pump is used to transfer oil from one line to another to maintain position synchronization of the ends of the ram.

The booster pump is driven by a motor supplied by an amplidyne generator, which is controlled by the photoelectric system. Any tilt of the ram raises or lowers a barrier suspended between the photoelectric cell and the light source. Movement of this barrier as much as a thousandth of an inch results in automatic correction through altered speed and direction of the oil flow from the transfer pump.

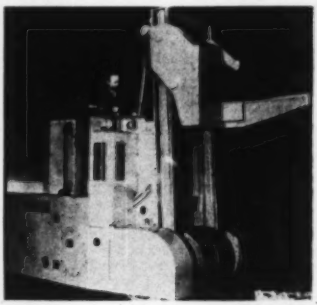
Vertical micrometer adjustment of the electronic unit permits the ram to be operated at a selected degree of tilt when required. According to Verson engineers, the electronic ram control is more efficient, more sensitive, and easier to operate than the customary mechanical tie or valve-and-limit-switch methods.

Giant Power Truck

A ram-type power truck for handling strip steel in coils weighing up to 40,000 lb has been built by Elwell-Parker Electric Co., Cleveland, Ohio, and shipped to an overseas steelworks. It is one of the largest constructed for steelworks use, about four times as big as the average size of fork trucks operating in factories and warehouses.

One advantage of the truck is that the ram can be raised or lowered to the level of a mill mandrel, moved up close in line with it, and the finished coil pushed quickly off the mandrel on to the ram. A coil may be transported to storage or packaging department, or moved to other mill units for further processing, such as reducing gage, slitting, pickling, galvanizing, or tinning.

In storage areas coils are placed edge to edge, in pipe-line formation. A truck can pick up one or more coils at a time depending on its capacity and length of ram.



That unit in the new truck is 50 in., enabling it to handle coils 62 in. wide. Its lifting height above floor level is 114 in.

Over-all length of the truck is 202 in. Maximum width is 105½ in.; height with elevating columns telescoped 154 in. Truck's travel speed is 2 mph; hoist speed with capacity load is at the rate of 5 to 10 fpm.

The truck is constructed to be powered by storage batteries, gas-electric, or Diesel-electric units. It has three electric motors, one for the drive wheels, one for the hydraulic steering mechanism, another for the hydraulic hoist. Basic operating controls are the same in number as on the smallest trucks—a lever

for steering, one for traveling forward or reverse, one for elevating or lowering the load, and a foot brake. But this truck is so wide that two sets of the controls are installed, one at each side of the driver's stand. The two brakes are connected by a rod clear across the truck. These dual controls enable the driver to operate from any position.

Laminating Material

A tacky low-pressure laminating material composed of glass fabric impregnated with General Electric Permafil resin permits molding layups to be made without the use of staples or other fastening devices. Permafil impregnated glass cloth is being marketed as Phenopreg LP-502 by Fabricon Products, Inc., River Rouge, Mich. Although tacky to the touch, Permafil glass fabrics are easy to handle and do not deposit resin on the hands of the user. The material is supplied ready for molding and storage life is good.

Presently being used for low-pressure molding of aircraft tooling jigs and fixtures, the material is being considered for the making of auto and airplane prototypes. Molding is done at temperatures about 300 F and at pressures ranging from 15 to 75 psi. Layups may be made over wood or plaster forms and molded by the vacuum bag method. Matched metal die molding may also be used. Parts molded have high mechanical strength, good moisture and chemical resistance, and excellent electrical properties.

The No. 3405 Permafil resin, produced by G.-E.'s Chemical Division, is applied to the glass cloth on standard impregnating equipment. The degree of tack on the treated fabric may be varied. Cellophane separators may be used between sheets of the impregnated glass cloth and it is not necessary to use polyethylene sheeting. Cotton cloth on soft paper may also be impregnated with the resin, and coatings may be obtained on high density papers or solid objects.

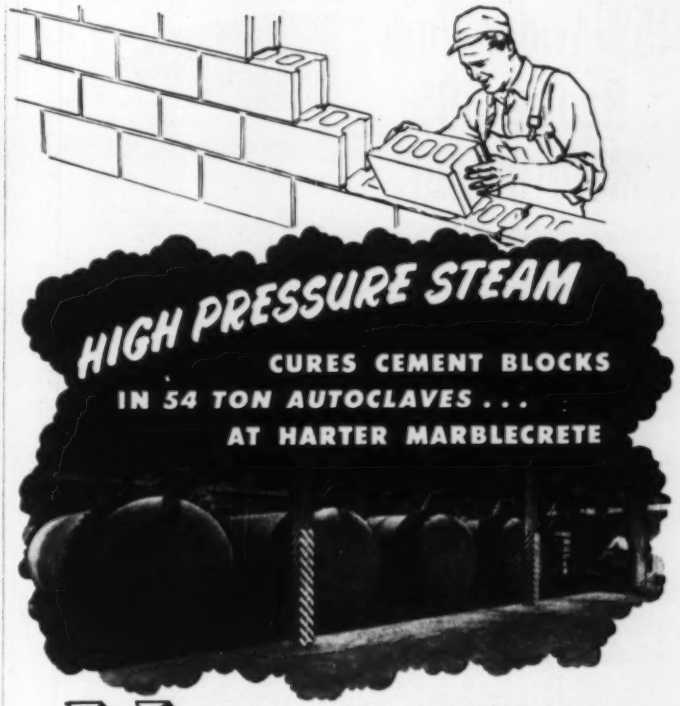
High-Speed Photography

A new 15-min 16-mm sound motion picture which provides a concise graphic demonstration of the ability of a high-speed motion-picture camera to "magnify time" has just been announced by the Eastman Kodak Co., Rochester, N. Y.

The film "Magnifying Time with the Kodak High Speed Camera" begins with the statement that time is no longer bound by the clock; that time control is now possible with a high-speed motion-picture camera.

To prove the point, and to show various applications of the camera, the film illustrates how every movement from dropping an egg in a frying pan to the implosion of television tubes can be slowed down to a snail's pace for leisurely study and analysis. Sequences in this series include motion-picture studies of explosions, the operation of relays, studies of cam action, the performance of a solenoid operated curtain, and vacuum coating of metals and plastics.

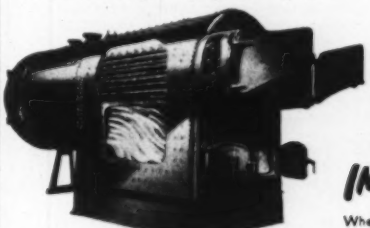
During the course of the demonstration the film points out that since the Kodak high-speed camera exposes 100 ft of motion-picture film in about 3 sec—while the film whizzes along at approximately 50 mph—time is multiplied by a factor of about 200 and as a result any movement or action which is too fast for the eye to follow in the normal course of events can be readily studied on high-speed film. This will provide the engineer or researcher with the rare advantage of seeing what really happens when things take place "quick as a wink."



● In the modern plant of Harter Marblecrete Stone Co., at Oklahoma City, cement blocks are cured with high-pressure steam at 135 to 150 psi in five of the *largest autoclaves ever built.* (Pictured above)

A further interesting fact about this outstanding development is the use of a 26-inch vacuum, pulled with an Elliott barometric condenser, for the drying stage.

High pressure steam is provided by a gas fired 300 hp Kewanee Boiler producing 10,500 pounds of steam per hour.



Cut-a-way View of KEWANEE "500" used in Harter Marblecrete Plant. Sizes for 40 to 304 hp . . . 100-150 psi.

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Wherever steam is needed . . . high or low pressure . . . there is a Kewanee Boiler just right. Ask for complete catalogs and information.

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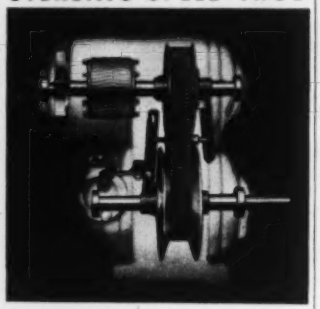
Production increased 30% with Speed-Trol driving our 200-ton Bliss Press, reports Mr. R. W. Blackman, President of Blackman Stamping and Mfg. Company of Los Angeles, because we can now select the maximum efficient speed for each job condition. Each selected speed setting is positive and steady for any load condition. The wide, infinitely adjustable speed range enables us to accommodate 15% more work functions on this machine.

STERLING SPEED-TROL



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"Magnifying Time" will be available on loan without charge to businesses, industries, organizations, and schools interested in the subject of high-speed movies. Bookings can be arranged by addressing Camera Club and School Service, Eastman Kodak Co., Rochester 4, N. Y.

Vacuum Calculator

An edition of the Stokes Vacuum Calculator is now available for free distribution for the first time. The slide rule, designed for quick calculations in vacuum research and processing work, has been developed by and is available from the F. J. Stokes Machine Co. of Philadelphia, Pa.

The Vacuum Calculator will determine the needed pump capacity to evacuate a given volume to a specified vacuum in a given time, and the time required to reach a specified vacuum in a given volume with a pump whose capacity is known. It will also determine vapor pressures of water at various temperatures, and capacities of round tanks in both cu ft per ft and gal per ft. On the reverse side of the rule there are useful conversion tables including an Antigrade-Fahrenheit graph and a chart showing boiling points of various solvents under pressure.

Line-Type Purifier

Another in the new series of Hi-eF purifiers recently developed by the engineering staff of the V. D. Anderson Co., Cleveland, Ohio, is the line-type purifier for installation on compressed air, gas, vapor, and steam lines. The line-type purifier has many applications throughout the chemical, petroleum, and metalworking industries. Chief of these are: (1) to remove guck and entrained solids from exhaust steam installations, (2) the removal of condensate from compressed air lines, (3) the delivery of clean dry steam for food processing, (4) to prevent process gas and air lines from becoming contaminated with line scale and liquids, and (5) to remove entrainment from vapor lines following evaporation.

A centrifugal element within the purifier gives the entrainment-laden vapor a rapid rotational motion. This causes the heavier entrainment to be thrown outward to the walls of the purifier where it is drained down and ejected.

Advantages for the unit claimed by the manufacturer other than low initial cost are no moving parts and the self-cleaning action which eliminates the need for maintenance, good design which reduces pressure drop to a minimum, large slug capacities, and broad range of capacities.

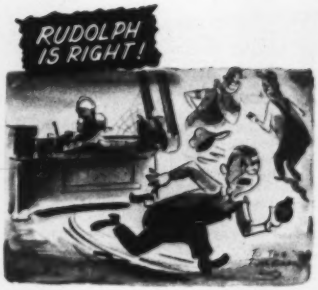
The unit is designed, built, and stamped to ASME Code for Unfired Pressure Vessels.

For further information write for bulletin No. 200 for sizes 2½ through 24 in. and bulletin No. 500 for sizes ½ through 2 in., available from the V. D. Anderson Co., Cleveland 2, Ohio.

Heavy-Duty D-C Contactors

New d-c contactors for steel mill and other heavy-duty industrial applications are available from Westinghouse Electric Corp., Pittsburgh, Pa.

Known as type M, the contactors are accessible from the front. Their alignment is independent of the accuracy of panel drilling, with only three mounting holes required. Contacts and shunts can be replaced easily without the removal of any other parts. Operating coils are removed by



"Using the Right Cutting Fluid Would Eliminate a Lot of Time and Money Wasted Changing Cutters"

There are literally thousands of examples to prove how the right application of the *right* cutting fluid can make a tremendous difference in machining efficiency. Here is another one which will help you realize the opportunities afforded by an open-minded look at your cutting fluids:

• **THE JOB:** Generator machining a 1" dia. worm gear, double thread.

COMPARISON OF CUTTING FLUID PERFORMANCE

	Previous Oil	Stuart's THREDKUT
Production per grind/dress	20 pieces average	190 pieces average
Finish	Passable	Satisfactory
Oil dilution	None	4 to 1
Cost of oil on machine	42c/ gal.	27.2c/gal.
Downtime during test	2½ hours	None

Think of the increase in cutter life (cost about $86.90 each). Before using Stuart's ThredKut they were reground 9½ times as often. Add to this the saving in downtime and the saving in cutting fluid price and you'll see why "Rudolph is Right."

Write for your copy of Stuart's Shop Notebook—a bi-monthly publication devoted to the selection and application of metal-working lubricants.

GET MORE PRODUCTION
Use The Right Cutting Fluid

STUART SERVICE
Goes with every Barrel
Offices in Principal Industrial Centers

D.A. Stuart Oil CO.
2741 S. Troy St., Chicago 23, Ill.

taking out three bolts. This unit construction reduces maintenance resulting from misalignment of separately mounted contactor parts.

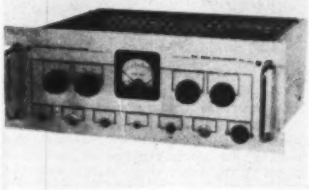
These type M contactors feature self-cleaning, knife-edge bearings that are not affected by dust. The design also incorporates a new-type arc box to provide faster arc interruption, and to maintain correct alignment with the moving armature.

Electrical interlocks are mounted directly on the contactor frame and maintain correct alignment with the moving armature. No operating linkages are required. Type M contactors are available in all NEMA ratings from 25 to 2500 amp.

Rack-Mounted DC Amplifier

A new direct-coupled amplifier, designed for use in standard 19-in. rack and having a 7-in-high front panel, is now available. Designated as Model BL-962 by the maker, Brush Development Co. of Cleveland, Ohio, the instrument was designed for use with Brush magnetic direct-writing oscillographs in studies of such static or dynamic conditions as strains, displacements, pressures, light intensities, temperatures, and a-c or d-c voltages or currents.

Voltage gain of the instrument, approximately 1000 times, is sufficient to give one millimeter of deflection on the oscillograph chart per millivolt input. Effects of power line fluctuation are minimized by novel design features combined with both plate and heater voltage regulation.

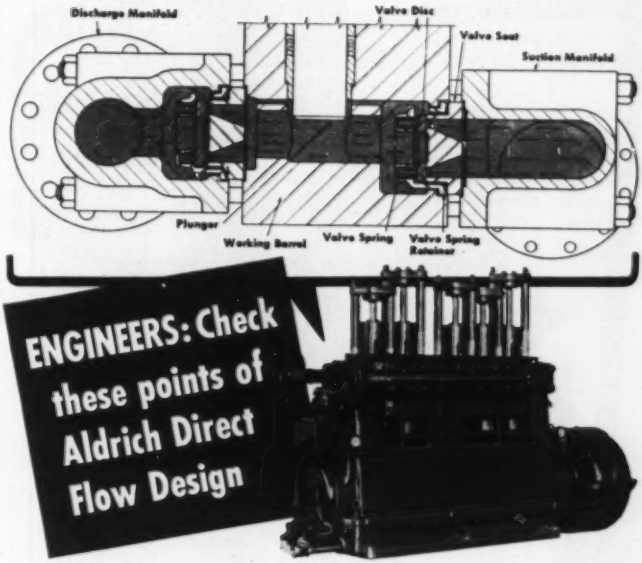


Zero signal drift amounts to not more than one chart millimeter per hour. When the amplifier is used with the penmotor, the frequency response is essentially linear from d-c to 100 cps.

The control panel on the face of the unit contains an attenuator with five factor-of-ten positions, gain control, calibrating meter, and controls for determining input voltages. A balancing potentiometer is provided for electrically biasing the oscillograph pen to any position on the chart. Input jack and output sockets are located on both the front panel and the rear of the chassis.

Open-Hearth Furnaces

Jones and Laughlin Steel Corp. of Pittsburgh, Pa., recently celebrated, with impressive ceremonies, the tapping of the first heat from new open-hearth furnaces at Pittsburgh. New furnaces will have a production capacity of 2,000,000 tons of steel annually. The expansion project, the largest ever undertaken by J&L., includes construction of 11 new open hearths to be completed by next March. This and other projects in the corporation's five-year $400 million expansion program to be completed in 1952, will increase J&L steel production by 32%.



Aldrich engineers eliminated two right-angle turns in the fluid-end. Now, liquid passes from suction to discharge manifold in a *straight line*. That gave the Direct Flow Pump its name, and set up a whole new concept of pumps, pumping, and pump maintenance. It all adds up as follows:

☐ **Increased operating speeds**—you get whatever volume and pressure you need *from a smaller, lighter, more compact pump.*

☐ **Sectionalized construction**—parts can be replaced at a fraction of the cost of a new fluid-end; also, parts can be made of stainless, bronze, Monel or other special materials—extremely important for corrosive fluid service.

☐ **Maintenance made easier**—no more tapered bores in the working barrel. Manifolds are *not* taken off but slide out on studs—affording room to *lift out* valves as complete units. Packing is easily renewed—note accessibility of stuffing boxes.

☐ **Interchangeable wearing parts**—available among 3, 5, 7 and 9 plunger pumps of same stroke size. This minimizes spare parts costs and inventories.

☐ **Changeable plunger sizes**—in many cases it is only necessary to add new plungers, glands, throat bushings and packing *to the same fluid-end.*

☐ **Drive direct**—by connection to synchronous engine type motor or internal combustion engine; also with integral speed reducer or V-belts.

Contact your Aldrich Representative . . . or write to us direct for complete details on 3", 5" or 6" stroke units.

THE ALDRICH PUMP COMPANY

29 PINE STREET, ALLENTOWN, PENNSYLVANIA

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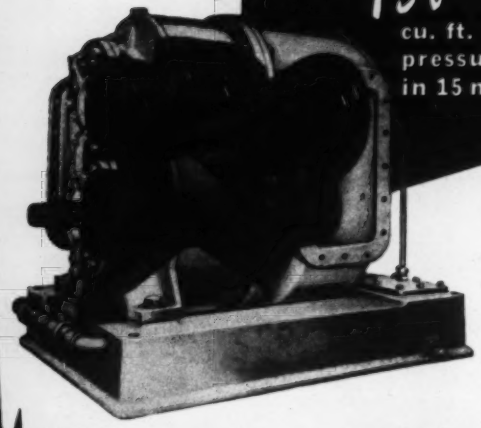
Representatives: Birmingham • Bolivar, N. Y. • Boston • Buffalo • Chicago • Cincinnati Cleveland • Denver • Detroit • Duluth • Houston • Jacksonville • Los Angeles • New York Omaha • Philadelphia • Pittsburgh • Portland, Ore. • Richmond, Va. • St. Louis • San Francisco Seattle • Spokane, Wash. • Syracuse • Tulsa • Export Dept.: 751 Drexel Building, Phila. 6, Pa.

this STANDARDAIRE handled 1/3 billion cu. ft. of high pressure air in 15 months



Then we dismantled the unit

. . . FOUND IT AS GOOD AS NEW

- Unit 9B16-213, for 15 months of day and night outdoor service, was operated beyond its rated capacity to meet unforseen demands. It was replaced by a larger Standardaire Blower. The engineer of this plant asked that the hard working unit be sealed and returned to our factory so that he personally could observe the dis-assembly and measurements for wear.
- Main and Gate Rotors like new —interior of blower completely dry and free of oil—no wear in other internal parts.
- Timing Gears on Gate and Main Rotors—wear very slight—no increase in back lash could be detected.
- Axial clearance of Main Rotor Shaft Thrust-Radial Bearing, increased less than .0005"—other bearings in perfect order.
- Even at the extremely high peripheral speed of these gears, they were found to be very quiet in service.
- Standardaire Blowers are sturdy —precision built units with proved staying power.

Write for specific data—Dept. F51. Read Standard Corporation, 370 Lexington Ave., New York 17, N. Y.

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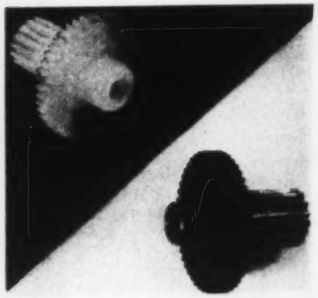
Features of the new plant include latest developments in open-hearth furnace design and use of refractories, instrumentation for high efficiency in the control of temperatures, heat and efficiency of fuel utilization; mechanized material-handling facilities; provisions for using tar, oil, or gas for fuel; and special facilities for the handling of scrap metal.

Molded Nylon Gears

Cost savings averaging 63 per cent have been obtained on gears for the G-E oscillating fan by replacing three metal gears with molded nylon gears produced by the Taunton, Mass., molding plant of General Electric's Plastics Department.

Rotating at a speed of 32 rpm with a maximum torque of 6.75 oz in., a molded nylon worm wheel and pinion alone permit cost savings of 65 per cent, as compared with the original construction of a steel pinion and laminated plastics gear where hobbing, cutting, and assembly operations were required.



Molded in a Fellows-Leominster injection press especially designed for economical nylon molding, no machining operations are required on the nylon wheel and pinion. Assembly operations are also eliminated since the two parts are molded as one unit.

Tests show that the nylon gears now used in two models of the G-E fan have excellent wear characteristics as compared with the previously used steel and laminated gears. Quieter operation, in addition to substantial cost savings, has also been obtained.

CO_2 Recorder

The Hays Corp., Michigan City, Ind., announces the availability of a new CO_2 recorder designed to meet the high standards of speed and accuracy of large industrial power plants and central stations. The instrument utilizes three established ideas:

1 The use of CO_2 measurement as a guide to combustion efficiency. This principle (that each gas has a distinct ability to conduct heat) has been used in thousands of boiler plants and industrial furnaces, particularly where a single fuel such as natural gas, oil, bituminous or anthracite coal is burned.

2 The thermal conductivity principle of gas analysis. This has been accepted extensively in the process industries, because of its fast response to changes in gas composition, its freedom from chemicals, and its proved reliability.

3 Electronic type operation. This frees the instrument of the step action and delicate construction commonly found in galvanometer operated instruments. It also adds greater speed, power, and magnification, while assuring high accuracy and permanency of calibration.

Because of the rapid change of sample gas in the gas passage system, the small volume of gas in the analyzing cell, and the continuous connection between the analyzer and the recording pen motor the Hays Condu-Therm CO_2 recorder achieves five second response to changes in the CO_2 content of the sample gas.

Not a laboratory instrument, the Condu-Therm is constructed for boiler plant use. It features (*a*) linkage of $^1/_4 \times {}^1/_2$ in. bar; (*b*) multiple pen bearing of telescoping stainless steel tubes; (*c*) Oilite bearings which do not require lubrication; (*d*) a chart plate of $^1/_4$ in. permanent mold casting; (*e*) unit construction for easy replacement of each main element.

Full information on the Hays Condu-Therm CO_2 Recorder is available in bulletin No. 51-1008.

New Turbine Generators

The Philadelphia Electric Co. has placed an order with the Westinghouse Electric Corp. for a 200,000-kw turbine-generator, largest single-shaft unit ever to be built. The turbine-generator will be installed at the new Cromby Station near Phoenixville, Pa., where, together with a 150,000-kw unit already under contract, it will bring the station's total capacity to 350,000 kw.

The turbine will be designed for steam at an initial pressure of 1800 psi and a temperature of 1000 F, with reheat to 1000 F, and will be a triple-exhaust unit.

The turbine will be built at Westinghouse's South Philadelphia Works and the generator at East Pittsburgh.

A new turbine-generator is also being built by Westinghouse for installation early next year at the Gorgas, Ala., power station of the Alabama Power Company. Valued at nearly $2 million, the 100,000-kw turbine-generator unit will be about 72 ft long and weigh 900,000 lb. Westinghouse engineers estimate that the unit will nearly consume its own weight in steam every hour in rotating the 70-ton rotor 3600 rpm. The tip speed of the last row of turbine blades will be 942 mph—well above the speed of sound.

It will require about 90 min to bring the generator to its peak operating speed, and would take 30 min for the machine to coast to a standstill.

The steam turbine is being built at the Westinghouse South Philadelphia, Pa., plant and the generator is under way at the Company's East Pittsburgh, Pa., plant.

New Pump Test Flume

A new test flume is being utilized at Allis-Chalmers West Allis Works to facilitate study of inlet designs for vertical, axial, and mixed-flow pumps.

Glass partitions in the side of the flume permit photographing a variety of phenomena including whirlpools terminating at the water surface, on the sides of the tank, the bottom of the tank, and between two pumps.

Some of the general solutions so far evolved to intake structure problems have been relocation or redesign of channel walls, floors, or ceilings; guide vanes for more uniform

Measure and Record Strain with PRECISION

6-channel unit

The Hathaway TYPE RS-10 PRECISION STRAIN INDICATOR

6, 12, 25 or 50 Channels

FOR PRECISION MEASUREMENTS OF STATIC STRAIN

Static strain in 1 to 50 channels can be measured in rapid succession. Individually-calibrated 21-inch dial provides an accuracy of ¼ percent. Smooth and accurate balancing controls for each channel. Continuously-variable gage-factor adjustment.

FOR RECORDING DYNAMIC STRAIN

The RS-10 can be used with an oscillograph (such as the Hathaway type S14-C) for recording dynamic strain, providing *accurate balancing* and means for *precision calibration of the records.*

MULTI-CHANNEL PRECISION MEASUREMENTS OF STATIC STRAIN

DYNAMIC STRAIN RECORDING TO 300 CPS WITHOUT AMPLIFIERS

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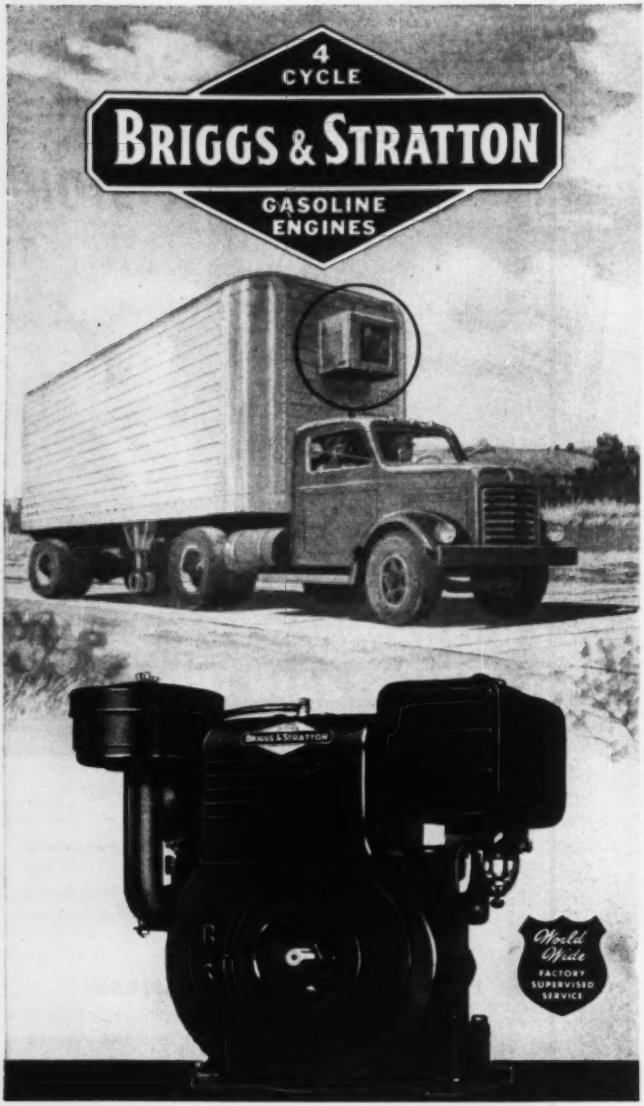

Preferred power for self-contained refrigerating units on motor-cargo trailers — the world's most widely used single-cylinder gasoline engines.

BRIGGS & STRATTON single-cylinder, 4-cycle, air-cooled gasoline engines are the "Preferred Power" leader — on equipment, machines, tools, appliances used by the transportation, construction, oil-fields and other industries — and on farms. Briggs & Stratton Corporation, Milwaukee 1, Wisconsin, U. S. A.

In the automotive field Briggs & Stratton is the recognized leader and world's largest producer of locks, keys and related equipment.

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flow; removal or redesign of obstructing members; baffles at or near the suction bell; floating grids to prevent air from being drawn into the pumps, and turning vanes under the suction bell.

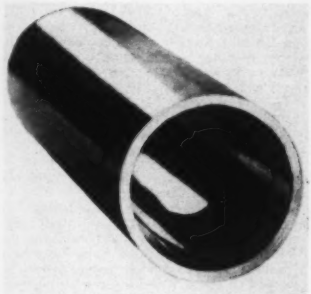
The tests are timely because vertical-mixed, and axial-flow pumps are finding increased popularity in powerhouse design. This is because they take less floor space than horizontal units, use higher speed motors, and make submergence of the impeller an easy matter.

Cylinder-Finish Tubing

A new line of tubing especially suited for use as hydraulic cylinders, shock absorbers, and other applications where pressure is to be converted into mechanical movement, has been announced by Tube Reducing Corp., Wallington, N. J.

Available in bores ranging from about $1^1/_2$ to 6 in. depending on wall thickness, the new tubing is free of scratches, pits, and other irregularities which are ironed out when the tube is sized by pressure exerted between two dies and a mandrel.

Because compression sizing cold-works the metal, the new cylinder finish tubing has better mechanical properties than hot-rolled or cold-drawn standard varieties. Mechanical properties of the original tube are greatly



improved, the exact extent depending upon the steel analysis and the amount of cold-working required in sizing.

Surfaces of the new cylinder-finish tubing are so smooth that they need no machining for use with leather or other soft packing such as is used for cup pistons. For use with metal piston rings, the tubing requires no boring but only a light honing operation.

Aluminum Reduction Plants

The first unit of the new 400 million-lb per yr aluminum reduction plant of Kaiser Aluminum and Chemical Corp. at Chalmette, La., will use condensers, deaerators, and boiler feed pumps manufactured by Worthington Pump and Machinery Corp., Harrison, N. J.

The Worthington equipment is to be used in the power plant cycle necessary for generating the great quantities of electric energy required for the aluminum reduction process. It will include thirty 9300-sq ft condensers, fifteen 250,000-lb per hr deaerators, nineteen 4-UX-2 boiler feed pumps. The total circulating water requirements are 330,000 gpm, which is to be supplied by Worthington vertical volute, dry pit type circulating pumps.

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NEW EQUIPMENT
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Two of the condensers will serve two 10,000-kw house units and the remaining 28 condensers will be used under the main units which are nominally rated at 20,000 kw each and have a capability of 25,000 kw. Two twin shells, having a total surface of 18,600 sq ft connected by an exhaust Tee piece, will serve each of two 25,000-kw turbine generators required to operate one pot line. This $150 million plant is part of an enormous expansion of Kaiser Aluminum which includes construction of its own power plant, use of 50 billion cu ft of Gulf area natural gas annually and the opening of bauxite properties in Jamaica to supplement present sources.

It was also announced that generators and turbines capable of producing 395,000 kw of electric power are included among more than $20 million of General Electric equipment now being readied for installation in two new aluminum plants.

Nearly $13 million of the equipment has been ordered by the Kaiser Aluminum & Chemical Corp. A separate $8 million order has been placed by the Reynolds Metals Co. for its two-pot-line installation now under construction near Corpus Christi, Texas.

In line with plans to increase the aluminum industry's over-all production to approximately 2½ billion lb annually, the two new plants are designed for an aggregate output of 550 million lb of the defense-vital metal each year.

Equipment ordered for Kaiser's Chalmette plant will be used in facilities designed to boost that firm's production by nearly 200 million lb a year, about half of the plants eventual output. A total of 80 G-E d-c generators, each developing 1200 kw and driven by natural gas engines, will provide power for two of the four Chalmette potlines. The remaining two lines now underway will be supplied by five 20,000-kw steam turbines. Two 10,000-kw steam turbines will provide power for plant auxiliaries. Other G-E equipment includes switchgear, control, and some 40 transformers ranging from 500 to 60,000 kva.

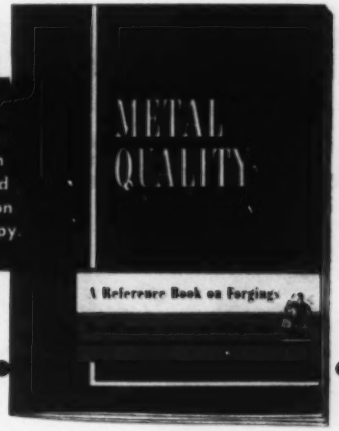
The Reynolds Co. is designing its new Corpus Christi plant for a capacity of 150 million lb a year. General Electric equipment includes 69 d-c generators, 38 rated at 2000 kw and 31 rated at 2500 kw. G.E. also will supply nine a-c, 3125-kva generators for general plant power, as well as switchgear, control, thirteen 1500-kva load center unit substations, and 10 other unit substations ranging from 500 to 1000 kva. This installation is part of an expansion program aimed at increasing Reynold's aluminum production by 200 million lb a year.

Fillerweld

Fillerweld, a new product designed to speed alloy-metal welding on applications where filler-metal must be added, has been announced by General Electric's Welding Department.

Used with gas-shielded arc welders, Fillerweld allows the operator to control the continuous flow of filler-metal automatically by means of a finger switch mounted on the torch. According to G-E engineers, the new welding attachment allows the operator to start or stop the flow of filler metal without breaking the arc, resulting in a smoother, faster weld. Wide application is expected on food and dairy equipment and in the fabrication of aluminum containers and light structural shapes.

Engineering, production and economic advantages obtainable with forgings are presented in this Reference Book on forgings. Write for a copy.



Never underestimate the preference of users of your product for the factor of greater safety that is inherent in forgings. This factor of greater safety results from toughness and strength, in correct proportion, as found only in closed die forgings. Consult a forging engineer about the mechanical properties required for your product.

DROP FORGING ASSOCIATION
605 HANNA BLDG. • CLEVELAND 15, OHIO

Please send 60-page booklet entitled "Metal Quality — How Hot Working Improves Properties of Metal", 1949 Edition.

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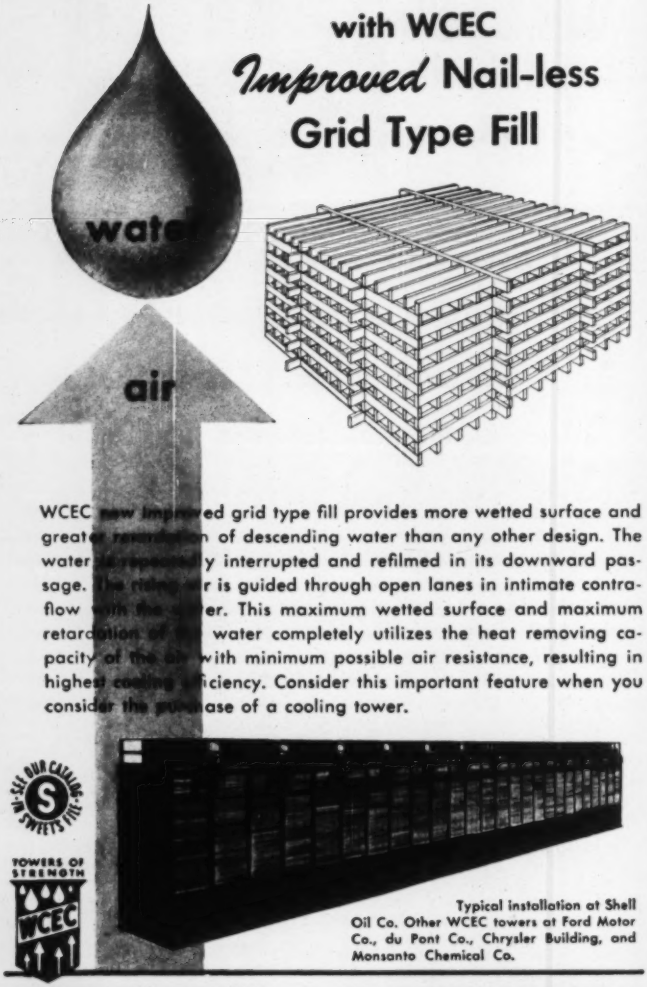
most wetted surface . . .

with WCEC *Improved* Nail-less Grid Type Fill



WCEC new improved grid type fill provides more wetted surface and greater retardation of descending water than any other design. The water is repeatedly interrupted and refilmed in its downward passage. The rising air is guided through open lanes in intimate contraflow with the water. This maximum wetted surface and maximum retardation of the water completely utilizes the heat removing capacity of the air with minimum possible air resistance, resulting in highest cooling efficiency. Consider this important feature when you consider the purchase of a cooling tower.

SEE OUR CATALOG IN SWEET'S FILE

TOWERS OF STRENGTH WCEC

Typical installation at Shell Oil Co. Other WCEC towers at Ford Motor Co., du Pont Co., Chrysler Building, and Monsanto Chemical Co.

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Fillerweld consists of two main elements—the torch or gun, and a mechanical power unit. The gun is basically a manual water-cooled inert-arc tungsten holder to which has been added a control switch, and a gear assembly for pulling the filler-metal from the spool to the arc through the gun. Rated at 250 amperes, the gun accommodates tungsten from 0.040 to $^{6}/_{32}$ in. in diam and up to 7 in. long.

The new process can be applied to best advantage on stock less than $^{3}/_{16}$ in. thick. However, where speed is not of paramount consideration, Fillerweld will produce a high quality weld on thicker material. The equipment can be used with a G-E Type WP inert-arc welding transformer for welding aluminum, magnesium, or beryllium copper; or with a G-E Type WD-4150 or WD-4200 for welding stainless steel, copper, inconel, steel, and other weldable alloys. Either argon or helium can be used with the equipment.

Gas Line Pumping

The Mississippi River Fuel Corp. has purchased an 1850-hp gas-turbine unit from the Westinghouse Electric Corp. An original experimental unit placed on test in 1946, the turbine was modified to make it suitable for gas line pumping, and was placed in operation at Wilmar, Ark., on the Mississippi River Fuel Corporation's gas line in May, 1949. The first gas turbine in the world to be used in gas line pumping, it was also the first commercial gas-turbine unit to be operated in the United States using natural gas fuel.

In late 1950 the Mississippi River Fuel Corp. completed installation of a parallel high-pressure line, and the unit was no longer required at Wilmar. It was moved to Farmington, Mo., and placed in service in January, 1951. In this new location it is used in winter to "pack" the end of the line and increase peak deliveries, and in summer to maintain required pressure.

The experience gained from this installation has proved that the gas turbine provides an ideal drive for high-speed centrifugal compressors used in gas line pumping. Its simplicity and small size make for easy, low-cost station installation, and it can be readily moved. It can also be shut down for extended periods and restarted without difficulty.

Micromotion Movies

The Eastman Kodak Company's Industrial Engineering Department, Rochester, N. Y., in co-operation with the Mechanical Engineering Department and other divisions of the company, is using micromotion movies in studying machine design. This differs considerably from the use to which Kodak—and many other companies—have heretofore put micromotion movies. Such motion pictures are normally used for motion-study purposes on manual operations and for time-study purposes to check and evaluate the performance of the people working on a job.

Micromotion movies are 16-mm motion pictures taken at a fixed speed of 1000 frames per min. They get their name from the fact that each frame represents one 1/1000 of a min. Thus, time-study and industrial engineers can divide a minute into 1000 parts and determine how long any machine or operator takes to perform any given operation.

At Kodak the usual procedure is for the engineer to take out a camera and some lights

and make micromotion movies of the operation to be studied.

The movies are then projected and the process is charted on a standard chart form. This enables the engineer to break the operation down into its component parts. A typical chart has two columns—one which represents the left hand, and one the right. What each hand does at all times during the operation, the type of movement (if any) that it is making, the length of time required for each movement, and whether or not the hands are engaged in productive activity, are all noted on the chart. Consequently, when the chart is complete the engineer can tell—almost at a glance—whether or not the operation is efficient from both a mechanical and operative standpoint, and if not what parts of the operation are the weakest.

With this chart as a starting point, the engineer begins to consider what can be done to increase production and efficiency and reduce costs. He studies the problem to decide whether a major redesign job is necessary, or whether a special jig, fixture, or completely new machine is called for. Whatever his decision, the engineer is likely to sketch his ideas of what the new jig, fixture, or machine should look like and how it should work.

At this point the engineer knows how long it takes to do the job in the present manner, and what it costs. He also has figured out what types of jobs, fixtures, or redesigned machines will be required to do the job in a more efficient manner.

To compare the methods the engineer then consults previously compiled elemental time tables. These tables—which provide time-study engineers with the amount of time required for almost any given movement or operation—enable the engineer to estimate just how long the proposed new method will take to produce the same result as the old. And, once again, knowing "time" the engineer can determine cost.

When the machine or technique devised as a result of the studies is completed and placed on the production line, production is checked with more micromotion movies to determine whether or not the desired goals have been achieved.

As a consequence of the startling results achieved in production, the use of micromotion movies is growing steadily at Kodak. Kodak's industrial engineers believe that this new use will in time definitely overshadow in importance the uses to which micromotion movies have been put by the company in the past.

Concrete Thickener Basin

In addition to current heating, ventilating, and air-conditioning work on two of the largest skyscrapers in Pittsburgh, Pa., and several apartment buildings, Dravo Corporation's Machinery Division of Pittsburgh also supplied and erected, in 1951, apparatus for many steel mills, chemical plants, power generating stations, marine ship builders, gas and oil transmission lines, and other essential defense production activities. Other continuing projects of the company were the manufacture and sale of the Dravo "Counterflo" direct-fired space heater and the Dravo Crane Cab Cooler.

In Western Pennsylvania, numerous projects were undertaken in connection with the efforts of utility companies to increase supplies of gas and electricity.

It's Nugent!

for Fuel and Lubricating Oil Filters

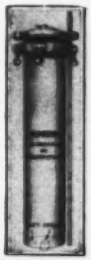
THE widespread use of NUGENT Absorbent Type Fuel and Lubricating Oil Filters is indicative of how the industry is conserving lubricating and fuel oils.

Figs. 1280 A 4L and 1280 AU 4L4, show two sizes of THE IMPROVED NUGENT DEPTH TYPE PRESSURE FILTER. These types are equipped with one to 12 standard filter cartridges in a single container or shell of various sizes, depending upon the filtering capacity required. All cartridges are alike and interchangeable regardless of whether they are the Repackable type or the Replaceable ("THROWAY") type. Both types are made for capacities from 1 up to 2248 H.P. in single containers or shells. (Navy specifications.)

This largest size contains only 12 recharges and filters a total of 182½ GPM lubricating oil. Compare this with other makes of filters containing 35 to 40 small recharges that must be stocked and handled each time you clean the filter.

NUGENT Fuel Oil Filters are made for Diesel engines from 1 to 384,000 H.P. in single containers.

Arrangement of 4 cartridges in 1 shell. Larger size shells are made to contain 3 to 12 cartridges.



(Above) A Nugent Filter shell containing one cartridge.

(Above) Replaceable "THROWAY" type recharge.

NOTE THESE SUPERIOR NUGENT FEATURES:

- **Easy and neat piping because inlet and outlet openings are opposite, close to the bottom.**
- **Filters have built-in by-passes—will take full flow or by-pass filtering.**
- **Drain plugs. Air vented.**
- **Reduces the neutralization number of lubricating oil from 0.40 to 0.04.**
- **Very inexpensive "THROWAY" Replaceable cartridges.**
- **Absorbs moisture four times its own weight.**
- **Traps abrasives such as gritty carbon, dust or metal particles.**
- **Safety: Patented construction prevents rupture and by-passing; all materials in elements harmless to engine; leaves the additives unchanged in modern compounded lubricating oil.**
- **Free flow: Entire outside surface filters oil. The patented center strainer core maintains free flow of the filtered oil and will not collapse nor by-pass under extreme pressure.**
- **Efficiency: Minute openings narrow toward the center; stop large particles first, small ones later, distributing dirt evenly through the element.**
- **Longer life because of larger filtering area.**

Wm. W. Nugent & Co., Inc.
407 N. Hermitage Ave. CHICAGO 22, ILLINOIS

You Get Trustworthy Liquid or Gas Cooling With Great Cooling Water Savings from the NIAGARA AERO HEAT EXCHANGER

● You can cool air, gas, water, oils, chemicals, electric and power and process equipment, engines, mechanical processes with lower cost and really accurate control of temperature with the Niagara Aero Heat Exchanger.

You are assured of uniform, constant production and quality from any process . . . steady, reliable operation . . . lower cost for more dependable cooling. You can have closed system cooling with freedom from scale, dirt, corrosion and maintenance troubles. You can accurately cool more than one type of liquid with one machine.

The Niagara Aero Heat Exchanger uses atmospheric air to cool liquids and gases by evaporative cooling. You can remove heat at the rate of input to keep accurate control of gas or liquid temperature. You can put heat back into the system to save the losses of a "warm-up" period or to equalize the effect of load variations.

Great savings in cooling water and savings in piping, pumping and power return the cost to you quickly. The Niagara Aero Heat Exchanger can save you approximately 95% of your cooling water cost. Write for Bulletin 96.

NIAGARA BLOWER COMPANY

Over 35 Years Service in Industrial Air Engineering

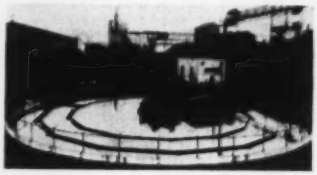
Dept. ME, 405 Lexington Ave. **New York 17, N. Y.**

Experienced District Engineers in Principal Cities of United States and Canada

Keep Informed

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

To minimize pollution of waterways from industrial wastes, Dravo's Apparatus Department installed various types of water clarification equipment for manufacturing plants. Outstanding in this type of work during 1951 was the completion of a blast furnace ore dust recovery system for the Jones & Laughlin Steel Corp. Aliquippa Works.



In this project, two 105-ft-diam concrete thickening basins were built to replace a blast furnace sludge settlement pond which occupied an area of approximately 130,000 sq ft. Previously, overflow from this pond discharged into the Ohio River.

The new equipment processes water containing ore dust to remove the solids which are filtered and treated for re-use in blast furnaces. Tons of usable iron ore are recovered daily in this operation, water drained into the river is cleared of solids and some 100,000 sq ft of additional land now is available for use.

Steel-Mill Water

Approximately 230 million gal of water daily—enough to supply two thirds of the needs of Philadelphia—will be pumped for all services at U. S. Steel's new Fairless Works at Morrisville, Pa.

The water will be supplied in three degrees of purity, through three individual systems: (1) general process water for cooling, quenching, and washing, (2) special process water for boilers, sanitary facilities, and showers, and (3) pure water for drinking.

These distribution networks will require about 25 miles of steel, cast iron, and concrete pipes ranging in size from 6 to 72 in. in diam and another 25 miles or more of pipe under 6 in. All pipes will be designed to flow full.

In a modern steel mill water is needed for almost every operation. It washes and quenches many rolled steel products. It is used to cool blast-furnace parts, open-hearth doors, mill rolls, and other equipment subjected to high temperatures. Blast-furnace slag is granulated by streams of water. Showers, sanitary facilities, drinking fountains, fire plugs—all must have adequate supplies at proper pressures. Blast-furnace gas is washed by water sprays, and steam from generators and blowers is passed through water-cooled condensers.

Compact Voltage Regulator

A more compact version of its "Rocking Contact" voltage regulator for small a-c generators has been announced by Allis-Chalmers Mfg. Co., Milwaukee, Wis.

The latest unit is available in two ratings, one with a 34-step commutator (Type V-00) and the other with 50 steps (Type 221). The former has a maximum rating of 157 kva at 3600 rpm and the latter a maximum of 438 kva at 3600 rpm.

Keep Informed

NEW EQUIPMENT
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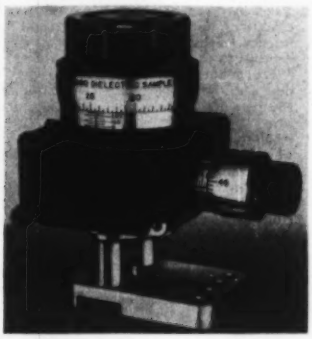
The improved regulator has been reduced in over-all size so that it occupies less switchboard space. Meterlike in appearance, the regulator is semiflush mounted to match switchboard instruments. It has a built-in voltage adjusting rheostat and is of dustproof design with all moving parts totally enclosed.

The regulator's Rocking Contact design does away with vibrating or sliding contacts. It is in motion only when change in excitation is required. Hunting is prevented by an elastically coupled damping system.

Further information is contained in bulletin No. 14B6143A.

Dielectric Sample Holder

The Type 1690-A Dielectric Sample Holder announced by General Radio Co., Cambridge, Mass., is a micrometer holder of the Hartshorn type with several important refinements in design. This type of holder is recognized in ASTM Specification D-150 for use in measurements of dielectric constant and dissipation factor on solid dielectric samples over the frequency range from 0.1 to 100 megacycles, and the holder can be used for accurate measurements of these quantities at audiofrequencies as well. Tests with this holder have established that accurate measurements of dielectric constant can be made to at least 500 megacycles but sufficient data are not as yet available for complete evaluation of high-frequency dissipation factor measurements.

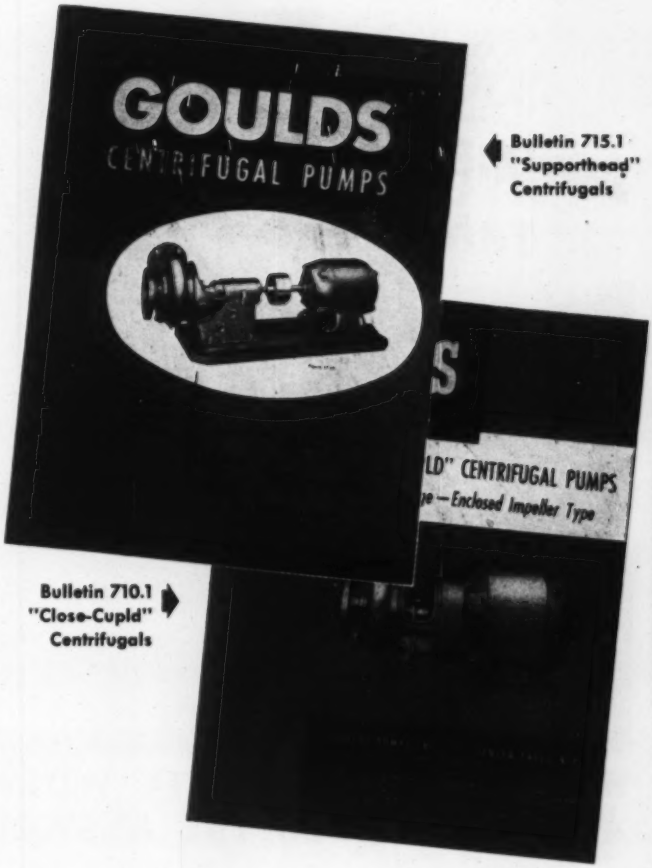


The holder uses a precision-ground micrometer screw to drive the movable grounded electrode and the spacing is indicated on a large calibrated drum readable to $^1/_{10}$ mil. The spacing range is from zero to 0.3 in. max. Both electrodes are ground to be optically plane within a few wavelengths, and are 2 in. in diam. A vernier capacitor with a range of 5 micromicrofarads is also provided for determining width of resonance curves in the susceptance variation method.

Multistage Mechanical-Drive Steam Turbine

A newly designed line of multistage, mechanical-drive turbines in ratings from 200 to 5000 hp has been announced by General Electric's Turbine Department.

Designated as types DP, DR, DRV, and DRVX, the new units have been designed to cover a wide range of industrial applications, as well as for power-generation purposes.



These new bulletins make it easier for you to select the right pump

These new bulletins have been designed to help you. New sizes are listed, and, in each bulletin we have put a composite rating chart which includes both "Close-Cupld" and the supporthead. This makes it dead simple to put your finger on the right pump for your requirements.

Another valuable feature of these bulletins is the parts chart. Using this you see exactly what parts are interchangeable for all size pumps and so can keep your spare parts investment to a minimum.

Use the coupon below to send for these useful FREE bulletins *today*. Goulds Pumps, Inc., Seneca Falls, N. Y.

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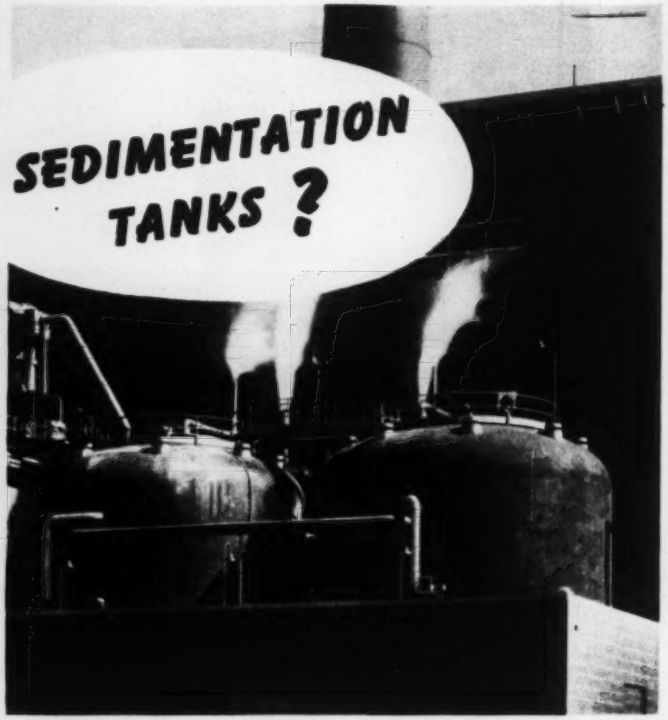

HORTON STEEL PLATE WORK
***AGAIN* PROVIDES THE ANSWER**

- Pushing their heads out of the power plant at the Corn Products Refining Company's huge operation at Argo, Illinois, are two Horton welded steel sedimentation tanks. They are part of a two-step water softening unit used to soften boiler feed water which the company takes from city mains. Both steps in this process involve the precipitation of sludge through heating and chemical action to reduce the hardness of water to 1 part per million.
- The two tanks, which are identical in shape, hold 185,000 gals. each. Welded steel construction insures leak proof joints and easier maintenance.
- We have had wide experience in building special steel plate structures for industrial use. You can benefit by making use of this knowledge. Write our nearest office for quotations on any tanks or steel plate work you contemplate installing.

CHICAGO BRIDGE & IRON COMPANY

Atlanta 3.....2113 Healey Building
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Chicago 4.....2466 McCormick Building
Cleveland 15.....2240 Guildhall Building
Detroit 26.....1511 Lafayette Building
Houston 2.....2136 C & I Life Building
Los Angeles 17...1518 General Petroleum Building
New York 6.....3301—165 Broadway Building
Philadelphia 3.1618—1700 Walnut Street Building
San Francisco 4.....1356—200 Bush Street
Seattle 1.....1321 Henry Building
Tulsa 3.....1610 Hunt Building
Washington 6, D.C.....1143 Carltz Building

Plants in: BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.

Keep Informed

NEW EQUIPMENT
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The type DP multistage turbine, rated from 200 to 3000 hp, is designed for driving pumps, compressors, fans, blowers, and similar equipment. It is equipped with a hydraulic governor which provides a 30 per cent speed range and 6 per cent speed regulation. These characteristics make it suitable for driving equipment which can be operated within its speed range and at a reasonably constant load factor.

The type DR turbine, rated from 200 to 5000 hp, is built for applications requiring wider speed range, greater accuracy of control, and greater capacity than can be obtained from the type DP turbine. The oil-relayed governor on the type DR turbine makes possible a speed range up to 6 to 1, with only 4 per cent regulation and $^1/_2$ per cent steady-state speed variation. This accuracy permits smooth parallel operation of a-c generators, according to G-E engineers. The speed range available with this turbine is sufficient to handle all types of variable speed pumps, fans, compressors, blowers, or stokers.

The type DRV, rated from 200 to 5000 hp, has the governing characteristics of the DR multistage turbine, but whereas the DR unit employs a single governor-controlled valve, the DRV utilizes automatic sectional valves linked to the oil relay governor. This arrangement minimizes throttling losses under fluctuating load factors and improves over-all heat cycle efficiency, resulting in operating savings, G-E engineers stated.

Casing construction on all three multistage turbines is similar. From two to ten stages may be used, depending on the steam conditions, application, and desired efficiency. Selection of the number of stages depends on the type of installation desired.

Fourth of the new units is the type DRVX, designed for applications where process steam is desired at a definite, steady pressure. Steam is extracted from one intermediate stage of the turbine at a pressure which is held constant even when the load on the unit fluctuates, and the flow of extracted steam varies. Exhaust steam may be condensed or applied to process requirements along with the extracted steam, engineers state.

Although speed governing characteristics of the DRVX are similar to the DRV, a pressure governor is added and connected to the speed governor for controlling steam extraction.

Electrical Steel

A thin electrical steel with unusual properties has been developed by Armco Steel Corp., Middletown, Ohio. Known as Tran-Cor T-O-S, it can be operated at very high inductions, 20% higher than any nickel-iron alloy.

The new material, thinner than most electrical steels, is intended for use in wound-type transformers and reactors which operate at 400 cycles. It was developed under a contract with the Bureau of Aeronautics of the Navy Department to permit the miniaturization and reduction in weight of airborne electrical equipment.

Tran-Cor T-O-S not only has a marked advantage in the low exciting current required at inductions over 16 kilogausses but also has a low core loss. Its minimum permeability at 18 kilogausses is 1800. This value is not usually attained, even at only 14 kilogausses, by the best grades of non-oriented high silicon steel.

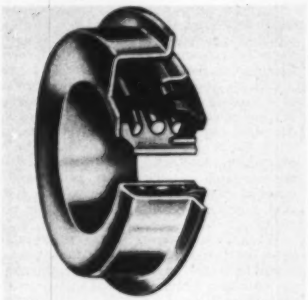
The new steel is an iron-silicon alloy with a high degree of orientation obtained by special processing and test-selection for high permeability requirements. It has a density of 7.65 grams per cu cm, a volume resistivity of 47 microhm-cm or 282 ohms/mil ft and a lamination factor of 95% solid.

Tran-Cor T-O-S is supplied in only 4-mil thicknesses and in $12^{3}/_{8}$-in-wide coils. It is surface-treated on both sides by special chemical and thermal processing, to insure low interlaminar energy losses. The surface treatment is unaffected by annealing.

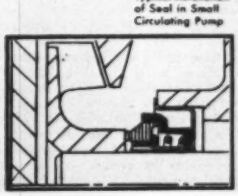
In addition to its unique electrical properties, the new steel has excellent workability. The strip can be bent flat over a small radius then straightened without cracking, and easily slit or sheared.

Mechanical Seal

A synthetic rubber flexing member encloses the spring of the new "John Crane" Type 11A Seal to protect it from corrosive liquids, according to Crane Packing Co., Chicago, Ill. Thus the spring need not be made of corrosion-resistant materials such as stainless steel. Another advantage is that the retainer does not contact the shaft so that various shaft sizes, namely $^{3}/_{8}$, $^{1}/_{2}$, $^{5}/_{8}$-in., and intermediate shaft diameters can be handled with one size seal.

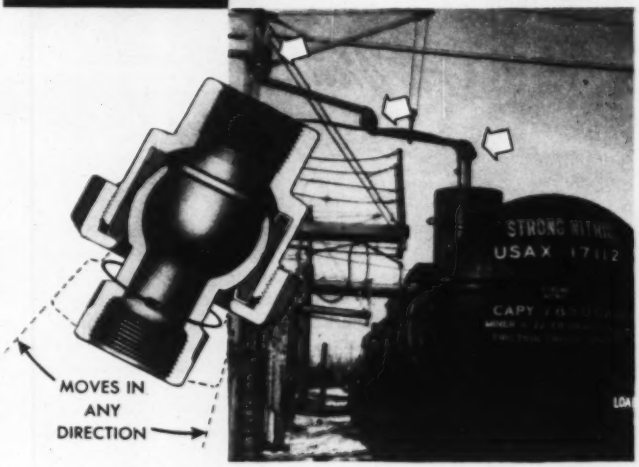


Typical Installation of Seal in Small Circulating Pump



Since the sealing unit is stationary (does not revolve with shaft) and because the rubber sealing member is flexible, this seal is recommended for high shaft speeds of 6000 rpm and over and for installations where shaft vibration is encountered. It is also designed to handle pressures up to 50 psi and temperatures to 212 F. Additional features: the type 11A Seal is compact—a "pressed-in," one-unit seal; the washer is held stationary by a metal retainer so that there are no damaging stresses on the flexible bellows; the new seal is easy to install on production lines; and its mass production means low unit cost.

BARCO Flexible BALL JOINTS



1. **MAXIMUM FLEXIBILITY.** Up to 40° side flexibility with 360° rotating movement.
2. **CHEMICALLY INERT GASKETS.** Barco offers a choice of seven types of gaskets including No. 11-CT for corrosive service. No lubrication required.
3. **NO METAL-TO-METAL CONTACT BETWEEN MOVING PARTS.** An important Barco advantage where corrosive chemicals are present, either externally or internally.
4. **STAINLESS STEEL BODIES.** Also regularly furnished in Malleable Iron, Steel, Bronze, Aluminum, and Magnesium. Other special alloy joints to order.
5. **MANY STYLES AVAILABLE.** Angle or straight; threaded or flanged connections. For pressures to 6,000 psi; temperatures to 1000°F. 15 different sizes, ¼" to 12".

—when you need movable joints in piping handling

CHEMICALS

■ The above photograph shows BARCO BALL JOINTS used to provide flexibility in Nitric Acid Tank Car Loading Lines at the Joliet, Ill., Arsenal. This is but one of many installations in industrial plants where Barco joints are used to allow movement in piping conveying acids, alkalies, and solvents—as well as steam, air, oil, gas, or water.

BARCO BALL JOINTS offer many advantages over ordinary types of joints or flexible connections. When you want to be sure of getting SAFE, long-lasting, trouble-free installations, specify BARCO! Ask for your copy of Bulletin No. 215. *Worldwide Sales and Service.* BARCO MFG. CO., 1821C Winnemac Ave., Chicago 40, Illinois. *In Canada:* The Holden Co., Ltd., Montreal.

BARCO

THE ONLY TRULY COMPLETE LINE OF FLEXIBLE BALL, SWIVEL, SWING AND REVOLVING JOINTS

Alabama By-Products Corporation to Make More Coke and Coal Chemicals

to Meet Southeast's Fast Growing Demands

ALABAMA BY-PRODUCTS CORPORATION of Birmingham—one of the Nation's largest commercial coke producers—is now rushing to completion the fifth expansion program in its history. Because of the tremendously increased demand for coke from the Southeast's flourishing foundry trade, the Company is building a new battery of coke ovens which will bring its capacity to over 900,000 tons a year. It is likewise stepping up the output of its coal chemicals and by-product gas.

"Our large expansion program helps assure an ample supply of quality coke for the Southeast's fast growing malleable and grey iron industry," says Phil H. Neal, president of ABC. "Capacity of our plant has been increased more than fivefold since our Company was organized. Biggest factor in our growth has been the broad-scale industrial development throughout the Southeast. Another is Birmingham's superior location as a distribution center—not only for the whole Southeast but for all the 31 States we serve and our export markets in Canada, Cuba and Mexico."

ABC is one of scores of Birmingham district enterprises that have spiraled from small beginnings into nationally known industries. New plants will find even greater growth opportunities because of the accelerating progress of the South. Stake your claim now.

* * * * * *

The Committee of 100 or any of the undersigned members of the Executive Committee will welcome the opportunity to give you confidential and specific data regarding the advantages of the Birmingham district for your plant, office or warehouse.

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Keep Informed

NEW EQUIPMENT
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RF Induction Heating

Radiofrequency induction heating is hardening several million textile shuttle tips per year at the Charles A. Richardson Company, West Mansfield, Mass. It's doing a better job than the old oil-fired furnaces—increasing production and decreasing rejects, floor space required, smoke, and fumes.

With r-f heating, it is possible to "selective"-harden the shuttle tips—24 different sizes of them—at production rates of up to 3000 per hr. Selective hardening, by means of exact and automatic process control, produces a high degree of hardness at the point, where maximum wear occurs, and relative softness for toughness at the points of maximum stress.

The carburizing furnaces previously used required 200 sq ft of floor space; the Westinghouse 20-kw r-f generator and integral work-handling equipment require less than 30 sq ft. The equipment is fully automatic, and can be operated by unskilled labor.

The work-handling equipment is arranged for manual loading, with automatic position, hardening, and discharge. A process timer built into the machine controls the positioning, heating, and quenching cycles, and reduces rejects because of uniformity of heat-treatment.

Step Gage

A new instrument for accurately measuring the thickness of thin films by means of color comparisons, has been announced by the Special Products Division of the General Electric Co., Schenectady, N. Y.

Called a step gage, the new device consists of a specially prepared glass plate enclosed in a plastic case. A film of barium stearate is deposited on the glass in a series of monomolecular layers, each layer having a thickness of 0.1 microinch. The successive layers are deposited in such a way as to build a series of steps made up of ten layers. Each step is one microinch thicker than the preceding one.

When the step gage is illuminated by white light, each step reflects a color that is determined by its thickness. The steps, therefore, are seen as a series of colored stripes on the glass plate.

To determine the thickness of an unknown film, it is compared with the colors on the gage to find the step which most nearly matches the color of the unknown film.

The new device will be used in the field of microchemistry for the measuring of small amounts of a substance when the substance is laid down in a uniform film, such as occurs in the case of films formed by evaporation in vacuum. It can also be used, indirectly, to measure vapor pressures and temper colors on metals, and is adaptable for measurement of transparent conductive coatings on glass—such as aircraft windshields.

Also expected to have wide application in technical education, the step gage will serve as an aid in teaching laws of reflection, polarization, and interference, and to help illustrate qualitatively, and quantitatively many of the laws which physical optic students study.

Range of the new gage is from 2 to 16 microinches.

Surge Comparison Tester

A new industrial electronic surge comparison tester is available from Westinghouse Electric Corp., Pittsburgh, Pa. It is used to locate

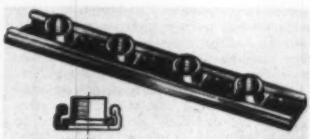
insulation faults and winding dissymmetries in motors, a-c and d-c generators, transformers, and coils.

The surge comparison tester, available in either mobile or portable models, is compact and movable, and has adequate surge voltage characteristics for most insulation tests. A wide flexibility in application and simplicity of operation are designed to make the surge tester adaptable to both manufacturing and repair work.

The tester simultaneously tests turn-to-turn, phase-to-phase, and coil-to-ground insulation with potentials high enough to simulate power circuit transient stresses. With every test setup, high-frequency and high-potential qualitative tests of resistance, impedance, and turn balance are made, and the results are obtained by a single scope observation. High turn-to-turn voltages are applied without excessive winding-to-ground stresses. Nondestructive testing is assured even on fractional horsepower motors and generators, and destructive fault location is possible in many cases.

Lock-Nut Fastener

A new multiple lock-nut fastener, called Kaylock Gang Channel has been introduced by Kaynar Mfg. Co., Inc., Los Angeles, Calif. Of small, compact design, the new product is interchangeable with the standard type of anchor nut. Containing the revolutionary spring steel lightweight lock-nut as inserts, this multiple nut fastener is narrower, lower, lighter, and stronger than any similar product ever produced.



Made of 24 ST Alclad aluminum alloy to Army and Navy Air Force specifications, the channel portion features a double-vertical wall, providing high "push out" resistance, plus maximum rigidity, thereby requiring less riveting for attaching. Its small nut size allows closer center-to-center spacing than ever before possible. The Kaylock Gang

when line "feathers" make the feathers fly...

... Switch to Arkwright Tracing Cloth! You can re-ink clean, sharp lines over any erasure without "feathering" or "blobbing" to spoil your work.

Painstaking Arkwright inspection guards your drawings against pinholes, thick threads or other imperfections—Arkwright quality insures them against brittleness, opaqueness, or paper-fraying due to age. That is why Arkwright Tracing Cloth takes clean, sharp drawings that yield clear, sharp blueprints years after you make them.

Remember: if your work is worth saving, put it on Arkwright Tracing Cloth. Would you like a sample? Write Arkwright Finishing Co., Industrial Trust Bldg., Providence, R. I.

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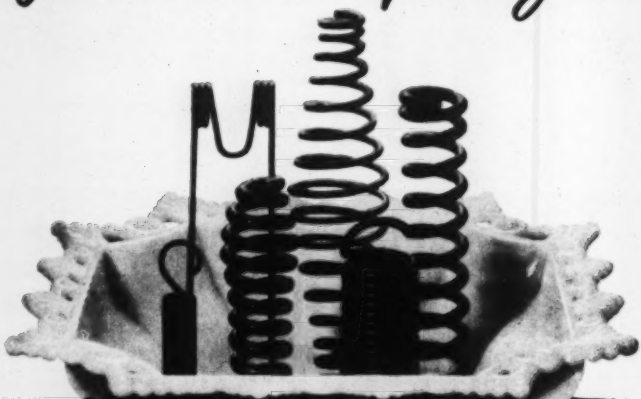
Tracing Cloths
AMERICA'S STANDARD FOR OVER 25 YEARS

RECIPE
for Better Springs



HOT OR COLD WOUND

PLACE thoroughly seasoned engineers in a modern plant.

ADD the finest spring-making equipment.

USING the latest metallurgical methods maintain the highest standards of quality

SERVE to customers precisely as specified.

AMERICAN-FORT PITT SPRINGS

AMERICAN-FORT PITT SPRING DIVISION
H. K. Porter Company, Inc.
No. 2 John Street, McKees Rocks, Pa. (Pittsburgh District)

Keep Informed — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Channel claims another first in being as narrow as a standard AN-366 anchor nut, thus making it possible to install this time and weightsaving product wherever standard anchor nuts were used.

Made presently in sizes ranging from 8–32 through 1/4 in.–28 size, the Kaylock Gang Channel is obtainable in either regular hole spacing or to any special hole pattern.

Seamless Stainless-Steel Tubing

Seamless stainless-steel tubing was produced on the new hot extrusion facilities of the Tubular Products Division of The Babcock & Wilcox Co., at Beaver Falls, Pa., for the first time in December, 1951, according to a recent announcement. It was revealed that the B&W plant is the first in the United States, designed specifically to produce stainless-steel tubing by the "Ugine-Sejournet" extrusion process, to be placed in actual operation.

The process makes it possible to extrude hollow and solid sections of metals which forge with great difficulty. It also permits much finer and more complicated sections than heretofore possible even with the more readily forgeable steel alloys. The distinguishing feature of this extrusion method of producing seamless tubing is the use of glass to act for an extremely short time both as a lubricant for the hot-worked metal and as an insulator to protect the die system.

B&W first announced its intent to produce tubing by the Ugine-Sejournet extrusion process in mid-1950 upon the completion of a licensing agreement with Comptoir Industriel d'Etirage & Profilage de Metaux of Paris, France, developers of the process and holders of the patent rights.

The first "lot" of extruded seamless tubing produced at B&W was B&W Croloy 18-8S, an 18% chromium 8% nickel stainless-steel alloy. The extruded tubes were subsequently "Roto-Rocked." The choice of stainless steel for the first lot of tubes produced by extrusion was felt by the company to be appropriate, inasmuch as it was back in 1922 that B&W produced the first seamless stainless-steel tubing in the United States.

Steel Developments

Four new processing developments shared news interest with progress in the construction of various features of Fairless Works at Morrisville, Pa., on the research and technological stage of United States Steel Corp. in 1951.

Meantime an up-to-date revision of United States Steel Company's exhaustive textbook on steelmaking was completed and distribution begun.

Major construction of the new 525 William Penn Place building in Pittsburgh, Pa., was completed and many of its tenants, including many U. S. Steel units, moved in from four other buildings across a bridge high above the traffic of the city's busiest thoroughfare.

Long-term railroad tests of corrosion of U. S. S. Cor-Ten, a high-strength low-alloy steel were completed and a customers' testing program launched. The new research laboratory of National Tube Co., a subsidiary, was inaugurated and this company announced a new casing for deep oil wells.

In the field of raw materials, Oliver Iron Mining Co., U. S. Steel subsidiary, completed the construction of a pilot plant for the nodulizing and sintering of ore fines and processed taconite at Virginia, Minn., on the Mesabi Range.

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2 In steelmaking, National Tube announced that it has successfully introduced the use of oxygen to speed up manufacture of steel in the Bessemer converter. As a result all past records were beaten for this fastest of processes—30 tons of steel in 9 to 10 min, 1 or 2 min less than the normal time; or a bonus of 30 tons of steel every 12 to 15 blows, 60 extra tons for each converter in an 8-hr day.

3 Completion of a new continuous annealing line at the Gary Sheet and Tin Mill was announced. With 3000 ft of sheet or strip in continuous process, this ingenious line is capable of giving a "universal temper" to 136,000 net tons of material each year for can manufacturers.

4 A new tin-plate coating thickness gage was put into operation. Adaptable to measuring tin-coating thicknesses for different kinds of cans, this new gage takes advantage of two ultramodern instruments, the x-ray and the Geiger counter. It is capable of measuring thicknesses with a margin of error less than 6 ten-millionths of an inch.

To improve its products and to assist customers confronted with unusual problems, National Tube Company began operating a new laboratory in Pittsburgh. Consisting of three stories and a basement, it contains the most modern equipment for testing materials and for conducting research in metallurgical problems.

This subsidiary, also in 1951, developed a tougher, stronger steel casing to withstand the tremendous pressures of today's deep oil wells. The new tubing composition is a quenched and drawn carbon-manganese steel which provides excellent toughness along with required strength.

Steel users were given the benefit of a special field corrosion testing laboratory service of U. S. Steel Co. If a customer or noncustomer seeks a special steel to perform a special job, tests of various suggested steels are made over months or years under actual service conditions in equipment operated in the plant of the inquirer. If the steel is to be used to manufacture a product, similar exhaustive tests are made in the field on the steel product as used by the purchaser.

Results of long-term tests, conducted in actual service to determine the relative performance of Cor-Ten and copper structural steel when used in railroad hopper cars, were tabulated and analyzed.

The program of the Research Laboratory, Kearny, N. J., of making high-speed motion pictures of the interior of a blast furnace has been extended to include furnaces at Gary Works and at Geneva Steel Co., Geneva, Utah. These films are now being compared with those taken of other furnaces. Various types of measurements are being made of all films now available. For example, measurement of the average size of the coke in the hearth of different furnaces reveals significant differences in results.

Motor Control Center

A completely new motor control center for use wherever two or more a-c motors (up to 200 hp, 600 volts) are controlled from a central location has been announced by General Electric's Control Department.

The new center, pre-engineered, factory wired and assembled, and employing many standard components and accessories, was developed for use in power stations, public buildings, paper mills, chemical, petroleum, steel, rubber, ore, food, and other processing plants.

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Additional information on the new motor control center is contained in publication GEA-4979A and is available from the General Electric Co., Schenectady 5, N. Y.

Business Notes

Blaw-Knox to Build Pilot Plant

A contract for the construction of a large pilot plant was awarded to the Chemical Plants Division of Blaw-Knox Co. by the Research and Development Div. of Pittsburgh Consolidation Coal Co. The pilot plant will be built at the coal company's research center at Library, Pa., and will be used for the partial conversion of coal, employing their newly developed low-temperature carbonization process.

Alcoa's Expansion Program

Broad and rapid expansion of Aluminum Company of America's facilities for the production of aluminum to meet the military and essential civilian needs of the nation was the company's biggest and most important job throughout 1951. The tremendous plant-building program undertaken by Alcoa under Government certification will increase the company's aluminum producing capacity by a full 55 per cent, and is moving ahead at full speed.

All told, the Government has authorized Alcoa to add a total of 205,000 tons to its annual aluminum-smelting capacity, all o which is expected to be in operation before the spring of 1953.

Two new smelting units, or potlines, are being added to Alcoa's existing plant at Point Comfort, Texas, increasing the aluminum-producing capacity there by 35,000 tons annually. Electric power for aluminum production at Point Comfort is generated by internal-combustion engines using natural gas as fuel. These new potlines should be in production this spring.

A new four-potline plant is now under construction by Alcoa at Wenatchee, Wash. This facility will have a capacity of 85,000 tons of aluminum per year. Required electric power will be supplied by the Rock Island dam development, and the first unit is scheduled for operation by mid-1952.

The building of still another new Alcoa smelting facility is under way at Rockdale, Texas, and aluminum production is sheduled to start there in the fall of 1952. It will also have 85,000 tons capacity, and will be the first aluminum plant in America to use electric power generated in a steam-electric station making use of lignite as fuel

The company's greatly increased smelting operations make necessary the simultaneous construction of large additional facilities for processing bauxite ore into the alumina (aluminum oxide) required for the actual smelting process. In 1951 Alcoa began the erection of a new alumina plant near its present mining locations at Bauxite, Ark.

Capable eventually of producing 400,000 tons of alumina annually, this plant is scheduled to begin partial operation in the summer of 1952.

Two existing Alcoa alumina plants are also included in the expansion. The alumina capacity of the company's works at East St. Louis, Ill., was nearly doubled in 1951 as a result of the completion of a $500,000 rehabilitation program. At Alcoa's Mobile, Ala., alumina plant, the capacity will be stepped up by 220,000 tons upon completion of new facilities now being built there. The Mobile expansion will be finished late in 1952.

The company is also making important additions to its research and fabricating facilities. Construction of a new section of the Aluminum Research Laboratories at New Kensington, Pa., will be completed early in 1952. A large forging press, having a 15,000-ton capacity, is being installed at the Cleveland, Ohio, works, and should be in operation within a few months. Leased to Alcoa by the Government, this great press will be used to make such items as landing gear parts, crankcases, jet-engine parts, propellers, and other large forgings for the aircraft industry.

Arrangements have been completed for the installation of a huge 13,200-ton extrusion press at Alcoa's plant in Lafayette, Ind. This will be the largest such press in the nation, and it is expected to be in operation by early 1953.

Koppers Builds Up New Research Center

Koppers Co., Inc., Pittsburgh, Pa., will embark on an enlarged and more unified program of research, with a major portion of such work centered at Verona, Pa., where new laboratories are now nearing completion.

The company has purchased a plant site it formerly leased at Verona, rearranged its buildings, and added a new building, which will contain administrative offices, the company's research library, and conference rooms.

Within a few months, a major portion of Koppers research will be centered at Verona, and by 1953 nearly 200 chemists, physicists, engineers, and technicians will be working there. Considerable new equipment is being installed in the laboratories and they will be modern in every way.

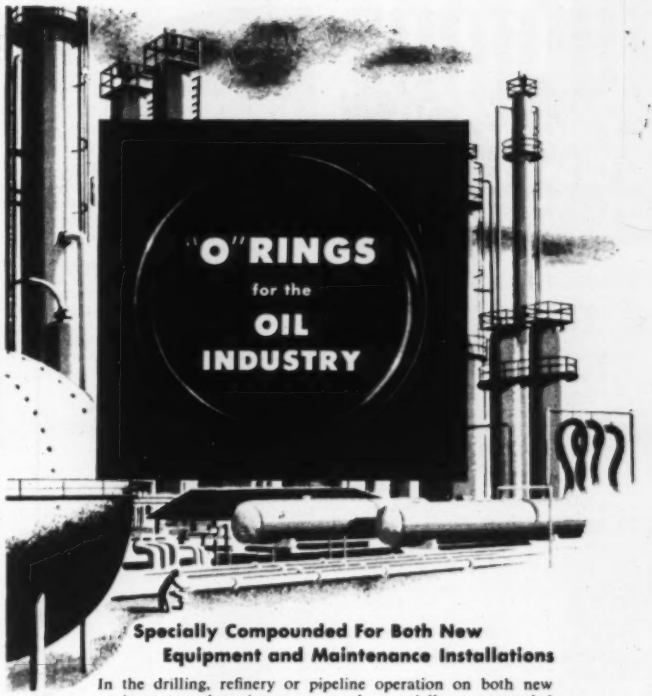
The new Verona center not only will provide enlarged and improved laboratory facilities but is designed to allow extensive pilot plant work to be carried on. One large area will be devoted to pilot plant work in chemicals, another in fuels, and a third in the testing and improving of large machinery which the company makes, such as electronic precipitators.

In these pilot plant areas, as many as ten miniature industrial plants may be in operation at the same time. One such plant, now planned, will make gasoline and oil from coal through the hydrogenation process.

The new facilities will enable Koppers to probe more broadly in the fields of coal chemicals, plastics, resins, wood preserving, and metal products and also to determine new fields of endeavor which the company may enter in the future.

Under agreement with Mellon Institute, a considerable number of fellowships there will be retained. These fellowships will be primarily of a basic research nature rather than in the realm of applied research.

Many of the research men who will work on Koppers projects at Verona were trained on fellowships at Mellon Institute.



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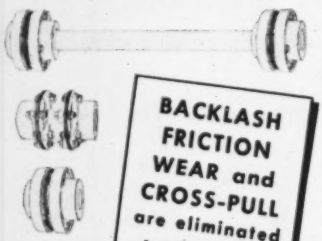

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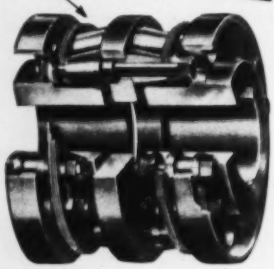

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Chicago Metal Hose now Flexonics Corp.

Effective Jan. 1, 1952, on the occasion of its Fiftieth Anniversary, Chicago Metal Hose Corp. became Flexonics Corp. The growth of the company and the development of varied product lines made it desirable to select a new corporate name more representative of the broad scope of company activities.

Flexonics Corp. has four U. S. plants located in Maywood, Elgin, Rock Falls, and Savanna, Ill.; an Eastern Assembly Warehouse in Elizabeth, N. J., and a Canadian subsidiary at Brampton, Ontario. The general offices of the company are at Maywood, Ill.

Farrel-Birmingham Acquires Common Stock of Consolidated Machine Tool Corp.

Farrel-Birmingham Co., Inc. of Ansonia, Conn., has acquired the common stock of Consolidated Machine Tool Corp., Rochester, N. Y., part of the consideration being securities of Farrel-Birmingham Co. The Consolidated plant will be operated as a subsidiary of the F-B Co. and will continue production of its well-established machine-tool lines.

Sterling Electric Opens New Plant

Sterling Electric Motors, Inc., started production in January, 1952, in their new $2 million plant on an 11-acre site in Van Wert, Ohio. The new factory is one of the country's most modern manufacturing plants for the production of gears, splines, and gear boxes. The plant was built to help speed the national defense program.

Sterling Electric Motors, Inc., manufacturer of Speed-Trol and Slo-Speed electric power drives, has in addition to its Los Angeles; Van Wert, Ohio; and New York plants, manufacturing plants in Hamilton, Canada, and Santiago, Chile.

G. E. to Expand Silicone Plant

An expansion program costing in excess of $5 million to greatly increase the production capacity of the General Electric silicone plant in Waterford, N. Y., has been announced. The Waterford plant, located on a 65-acre site, is now producing silicone fluids, greases, rubbers, resins, and water repellents. The contract for the new building program has been awarded to United Engineers and Constructors of Philadelphia, who erected the original plant in 1947.

Additional manufacturing facilities are now being installed and it is planned that the new facilities will be operating by the end of 1952.

Whitney Chain Co. Expands

Construction is progressing rapidly on the modern, one-story plant addition of Whitney Chain Co., Boston, Mass. The new building contains approximately 10,000 sq ft of additional floor space and will be devoted to the manufacture of fabricated steel sprockets and the large pitch roller and conveyer chains now greatly needed by both civilian and military users. The equipment for sprocket manufacture will be moved from other departments to permit reorganizing and expansion in the new building.

In addition, new press capacity will be installed, including heavy presses ranging from 280 to 400 tons.

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Philippine Utility Orders Three Unit Power Plants

The Manila Electric Co. has ordered three unit power plants, with capacities totaling 20,000 kw, from the Westinghouse Electric International Co. for installation at its Blaisdell station. The three units, two 5000-kw turbine-generator units and one 10,000-kw unit, will more than double Blaisdell's present 16,500-kw capacity, and will add 17 per cent to Manila Electric's total power generating capacity. The utility is a subsidiary of the General Public Utilities Corp. In addition to the three unit power plants, Westinghouse will supply three boilers, each with a capacity of 100,000 lb of steam per hr, and will supervise the entire installation.

Latest Catalogs

Gas Scrubbers

Complete with a capacity curve sheet, cross-section diagram, and other technical data including typical installation pictures, a new 6-page two-color bulletin, No. 203-B, is available for distribution by Peabody Engineering Corp., New York, N. Y.

Filter Gauges

Builders-Providence, Inc., Providence, R. I. has announced a new bulletin on Filter Gauges, mechanically operated. This bulletin, No. 450-H10, describes the various models of Filter Gauges manufactured by Builders-Providence. In addition to the description of these instruments, this bulletin also briefly relates the principle of operation used in these gages.

Expansion Joint Design Guide

An illustrated catalog, No. CMH-127, describing all types of corrugated expansion joints has just been released by Flexonics Corp., formerly Chicago Metal Hose Corp., Maywood, Ill. Complete specification and installation data for Flexonics-type free-flexing joints, for low-pressure applications; controlled-flexing joints, for greater amounts of traverse, and Flexoniflex joints for extremely high pressure applications, are given. Also covered are dual, hinged, balanced, and bulkhead units.

Combustion Oil and Gas Burners

A new four-page bulletin, Form AD-101, presenting the features of Hev-E gas and combination oil and gas burners for commercial and industrial use has been issued by the Cleaver-Brooks Co., Milwaukee, Wis. The bulletin points out the advantages of the five models of burners produced by Cleaver-Brooks. Complete with illustrations of the models, the bulletin stresses the efficiency, flexibility, cleanliness, economy, and ease of operation of the units. Also described are the forced-air draft system and the electronic controls that are important features in the burners.

Package Pumps

Allis-Chalmers package pumps engineered for a wide range of fractional horsepower applications, including air conditioning, in capacities to 80 gpm at heads to 100 ft are described in a new bulletin released by the company. The pump unit is available in four different types—open and closed impeller close-coupled, pedestal-mounted, and open impeller vertical mounting type. The latter has a special cover plate and flange. Performance data and dimensions for the various types are given in the bulletin. The closed impeller unit is available in 1 × $^3/_4$ and 1$^1/_4$ × 1-in. sizes and the open impeller in 1 × 1 and 1$^1/_2$ × 1$^1/_2$-in. sizes. Copies of the bulletin, No. 52B7529, are available from Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Heat-Treating Slide Chart

To put authoritative heat-treating data into the hands of tool and diemakers and heat-treaters, The Carpenter Steel Co. of Reading, Pa., has prepared a new compact heat-treating slide chart.

Measuring only 5 × 11 in. the chart is convenient to use yet gives complete answers to items such as heating speed, furnace atmosphere, temperature for drawing, and time for drawing. The chart contains data on type analyses of the more popular types of die steels, forging heat, annealing treatment, and hardening treatment. It also includes facts on quenching, effect of drawing temperature on hardness, and others.

ENGINEERING SOCIETIES YEARBOOK

This book provides information on the purpose, aims, policies, etc. of 318 organizations, including 83 national engineering societies; 174 state, regional and local clubs, councils and societies; 8 international engineering associations; 3 engineering employee organizations; and 5 engineering joint bodies.

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PRINCIPLES OF INDUSTRIAL MANAGEMENT

L. P. ALFORD, *Co-editor,* PRODUCTION HANDBOOK; and H. RUSSELL BEATTY, *Pratt Institute.* A standard in the field of modern management. "This revised edition . . . incorporates the many developments which occurred in the past decade. Special attention is given to the many changes in concepts and practices of industrial management which developed out of World War II and in the years immediately following. The book features a more quantitative and factual treatment of methods, techniques and practices of management . . . Some of the chapters which will be of direct interest to plant engineers are: control of stores-keeping, motion and time study, material and labor costs, overhead, maintenance of buildings and machines, and industrial safety . . ."—PLANT ENGINEERING. *780 pp., 172 illus.,* $6.00

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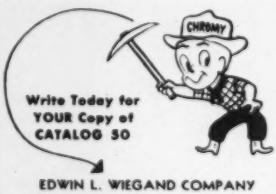

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Industrial Adhesives

Because of the widespread interest in the field of adhesives and the growing use of adhesives to do many industrial jobs, a new 32-page manual, "Armstrong's Adhesives for Industry," is available from Armstrong Cork Co., Lancaster, Pa. The new booklet not only describes Armstrong's own adhesives but will also help those who may not be intimately familiar with the subject to buy and use industrial adhesives to the best advantage, and to stimulate new ideas for the profitable use of adhesives.

O-Ring Data Sheet

The Arrowhead Rubber Co., of Downey, Calif., has made available, an "O" Ring Data Sheet and, by means of this form, is offering the expert technical advice of their "O" ring engineering specialists to designers faced with any problem involving the use of this type seal.

The Data Sheet offers a solution to the problem of selection of the proper ring, and provides expert "trouble shooting" in cases of ring failure where there is a question as to the exact cause. To obtain advice, the designer simply fills in on the form, details of the conditions under which the ring operates and other pertinent data, and returns the Data Sheet to the company. The problem is reviewed by Arrowhead's "O" ring engineers immediately upon receipt of the Data Sheet, and recommendations are forwarded promptly.

A supply of "O" Ring Data Sheets can be obtained by writing to the "O" Ring Technical Service Dept., Arrowhead Rubber Co., Downey, Calif.

Full Product Line

The Trane Co., La Crosse, Wis., has recently published its first complete, condensed catalog of the full line of Trane air conditioning, heating, ventilating, and heat-transfer equipment in five years. The 36-page "products" bulletin, No. PB-290, supplements some 40 specialized bulletins on various Trane product lines, providing a concise cross section of "... all the basic equipment required for practically any heating and air conditioning system." The catalog presents terse descriptions of each line, supplemented with cutaway drawings, products and parts photographs, construction features, and condensed tables summarizing the range of capacities, sizes, and dimensions. New Trane developments, introduced during the past five years and featured in the bulletin, include the CenTraVac hermetic centrifugal water chilling units, new reciprocating compressors, centrifugal fans, and gas-fired unit heaters.

The catalog also describes Trane Custom Air and UniTrane multiroom air conditioning systems, Unit Air Conditioners, Evaporative Coolers and Condensers, Convectors, Unit Heaters, Roof Ventilators, Wall-Fin, Unit Ventilators, Steam and Hot Water Heating Specialties, Heating Coils, Cooling Coils, Brazed Aluminum Heat Exchangers, and other specialized Trane products.

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Valves

The Wm. Powell Co. of Cincinnati, Ohio, have recently issued their new 589-page No. 11 General Catalog. It describes in detail the standard Powell bronze and iron valves, quick-opening valves, and all-iron valves.

Expansion Roof Tanks

Graver Tank & Mfg. Co., Inc., East Chicago, Ind., announce availability of a new booklet covering Graver Expansion Roof Tanks. Covered are single and multiple tank installations, design features, fittings, technical operating data, and operating analysis.

Diffusion Pumps

A new DPI Data Sheet which describes and charts the characteristics of Type MCF diffusion pumps is offered by Distillation Products Industries, division of Eastman Kodak Co., Rochester, N. Y. The new Data Sheet points out that this series of all-metal fractionating pumps is recommended for evacuation of large electronic tubes, particle accelerators, and other devices requiring an ultimate pressure of less than 10^{-8} mm Hg. The pumps described range in size from a 2-in-diam model suitable for exhaust of cathode-ray tubes to pumps several feet in diameter used on giant synchrocyclotrons and linear accelerators. The ultimate vacuum of pumps such as these is 5×10^{-7} mm Hg at 25 C without cold baffles or traps.

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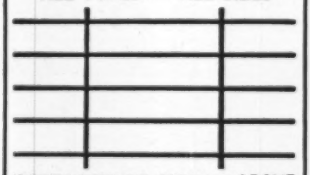

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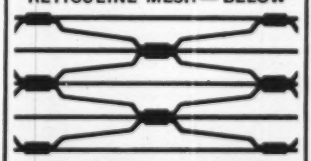

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Bending Manual

A new 32-page Di-Arco bending manual is available from O'Neill-Irwin Mfg. Co., Lake City, Minn. The booklet contains detailed illustrations, is informative, and contains ideas that are applicable to any rotary-type bender.

Copying Machine

A new booklet, No. A-2009, issued by Charles Bruning Co., Inc., New York, N.Y., describes the new Copyflex Model 20 machine for copying. The Model 20 is especially designed to provide a low-cost standard 46-in. printing width machine for producing a medium volume of copies.

Cylinders

Calling attention to several industrially proved installations of Ledeen cylinders in over 12 different fields is bulletin No. 152, released by Ledeen Mfg. Co., Los Angeles, Calif. Application of Ledeen cylinders is illustrated and described in such widely varied fields as chemical plants, oil refineries, plastics concrete plants, and lumber mills.

Machining Copper Alloys

A 32-page booklet, No. B-3, suggesting cutting speeds, feeds, tool rakes, and clearances to be used on more than 40 different copper alloys is offered by The American Brass Co., Waterbury, Conn. This guide is based on the use of standard cutting tool materials and contains many helpful and practical suggestions on turning and cutting-off tools; form tools; drills, reamers, and taps; thread chasers, milling cutters, and coolants.

Diesel Exhaust Hose

An illustrated bulletin describing flexible metal hose and tubing for Diesel applications has been released by Chicago Metal Hose Corp., Maywood, Ill., (now Flexonics Corp.). This bulletin deals with CMH Diesel exhaust hose—Rex-Weld corrugated types for higher pressure installations and Rex-Tube convoluted types, essentially used where long lengths of flexible exhaust tubing are required. Also covered are Rex-Weld types for Diesel air, oil, and fuel lines, and standard fittings for all Diesel exhaust hose types. The new bulletin was published to meet the widely expanding conditions in the Diesel industry.

ERW Tubing

The scope of sizes of electric resistance welded carbon steel tubing produced by the Welded Tube Div. of The Babcock & Wilcox Tube Co., Alliance, Ohio, has been broadened. As an aid to those using ERW tubing for either mechanical or pressure purposes the company has published a chart covering the range of sizes which they now produce. This chart is broken down to reflect both average wall and minimum wall requirements in 0.08/0.18% and 0.20/0.30% carbon steel grades produced to various ASTM, ASME, AAR, and government specifications for pressure tubing and standard specifications for mechanical tubing. It covers a size range of $\frac{1}{2}$ in. to 4 in. inclusive OD and 0.032 in. to 0.213 in. average wall thickness or 0.030 in. to 0.203 in. minimum wall thickness.

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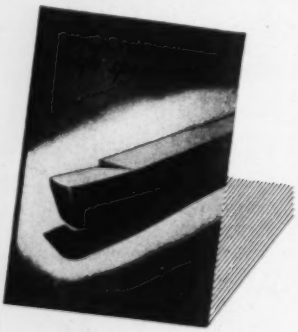

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Soil Compaction

Detailed information, including useful new production data, for figuring work schedules and costs on soil compaction jobs is contained in a new bulletin just published by Barco Mfg. Co., of Chicago, Ill., covering the use of the Barco portable gasoline "rammer" for tamping fill or back-fill in restricted areas. Of special interest to builders, contractors, supervisory engineers, and project managers is a discussion of the use of soil compaction as a means of attaining greater permanence, lower costs, and earlier completion dates on many construction projects.

Induction Heating

A new four-page, two-color bulletin No. EA-5682 describing a new heat-treating machine (G-E Type HM-40-PV) for handling parts to be induction-hardened progressively, is available from the General Electric Co., Schenectady 5, N. Y. The fully illustrated bulletin describes the features, applications, and specifications of the heat-treating machine which is to be used with either m-g or electronic-type induction heaters for hardening or annealing selected areas of parts up to 3 in. in diam and 40 in. in length.

Standard Rated Furnaces

A new illustrated bulletin, No. SC-151, describing the complete line of "Surface" Standard Rated Furnaces for every toolroom heat-treat requirement is now available from Surface Combustion Corp., Toledo, Ohio. Emphasizing methods of precise heat-treatment for maximum tool life, this bulletin describes controlled atmosphere furnaces and generators in addition to direct-fired, forced-convection, and pot furnaces.

Spray Nozzles

Up-to-date information on non-clogging spray nozzles for cleaning all kinds of materials, screens, fruits, vegetables, etc., is given in a new 4-page illustrated folder No. 2386 released by Link-Belt Co., Chicago, Ill. These nozzles consist simply of a scientifically shaped, curved bronze deflector having a smoothly polished water contact surface and a sharp, true discharge edge—with a U-bolt and two hexagon nuts for holding the deflector in proper position on a pipe drilled with a plain hole at each desired spray location. Folder shows installation pictures and how simply the nozzle can be applied. Tables give dimensions of nozzles for pipes of 1 to 3 in. in diam, and the capacity in gal per min through orifices of $^{5}/_{32}$ to $^{1}/_{2}$ in. diam at pressures of 20 to 100 psi.

Pickups

Pickups and how to choose them—the answers to critical application questions regarding amplitude and accelerations; frequencies; nature of motion and range of temperature are contained in a new bulletin, No. CEC-1503, available from Consolidated Engineering Corp., Pasadena, Calif. The pickups described are widely used as primary sensing units in vibration and acceleration studies. Attached to the machines or structures under test, they convert the motion to a varying, proportional voltage which may then be read on vibration meters, in terms of amplitude and frequency; viewed on an oscillograph screen, or recorded permanently by a multichannel recording oscillograph.

Steam Turbine Generators

Design and construction features of Allis-Chalmers WA-Series steam-turbine generator units manufactured in NEMA ratings of 2000 to 7500 kw are described in a new bulletin released by the company. The WA-Series units are built in the condensing type, for power generation only, and in the noncondensing and automatic extraction types to provide a steam-power balance where process steam is used.

Cross-section views of each of the turbine types are shown as well as cross sections of the steam-turbine generator unit, of the construction of governing valves and operating mechanism, and a cutaway view of WA-Series housing type generator showing spiral air flow in the stator.

WA-Series turbine-generator units are compact, three-bearing, solidly coupled units. Two of the three self-aligning bearings are in the turbine and one is in a bracket on the outboard end of the generator. All bearings are lubricated and cooled by oil supplied by a unit system through accessible piping located above the floor and within the unit.

The bulletin points out that WA-Series steam-turbine generator units feature such flexibility and simplicity in design that a wide range of applications can be met with a custom-built combination of standard components.

Copies of the bulletin, "WA-Series Steam Turbine Generator Units," 03B7654 are available upon request from Allis-Chalmers Mfg. Co., 949 S. 70th St., Milwaukee, Wis.

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TORQUE WRENCHES
Read by Sight, Sound or Feel.
Permanently Accurate
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in inch ounces inch pounds foot pounds
(All Sizes from 0-6000 ft. lbs.)
STURTEVANT TORQUE MANUAL
Every manufacturer, design and production man should have this valuable data. Sent upon request.

Heater Selection

Selection and application of Trane Torridor blower-type unit heaters are explained in a revised 56-page catalog, No. DS-327-A, published recently by The Trane Co., La Crosse, Wis. The new condensed bulletin provides complete capacity information and performance data on Torridors with capacities from 100,000 Btu to 1,500,000 Btu. Models described in the bulletin deliver heat from floor, wall, or ceiling, directly or through ducts. The bulletin graphically shows 10 different outlet arrangements, optional dampers, mixing boxes, and wall intake boxes and filters.

Production Control

Publication of a new 56-page book, "Production Control Systems and Procedures" has been announced by the Management Controls Division of Remington Rand, Inc., New York, N.Y. The book details a unique method of materials control that results in a shorter production planning cycle while speeding production by eliminating the causes of varied delays on the production line.

New Industrial House Magazine

"Alco Products Review," a new magazine devoted to the design and installation of heat exchangers, pressure vessels and pipe for the oil refining, chemical, and power industries, was published November 15 by the Alco Products Division of the American Locomotive Co., Schenectady, N.Y. The magazine, which is an 8½ × 11-in., two-color format, featured in its first issue a technical article on feedwater purification at the Hickling Station of the New York State Electric and Gas Corporation at East Corning, N.Y. Other articles describe air-cooler selection factors and assembly-line fabrication of aircraft engine containers. Picture stories of heat exchanger and pressure vessel installations in the petroleum refinery field are included. Copies may be obtained by contacting any of the Company's sales offices in New York, Chicago, Los Angeles, Kansas City, Houston, Tulsa, Dunkirk, and Beaumont.

Measuring and Testing Equipment

A new 80-page catalog, No. GEC 1016, summarizing for the first time under one cover all of the General Electric Company's testing and measuring equipment for laboratory and production line use, is available from the Company, Schenectady 5, N. Y. To be used primarily as a reference to the apparatus available for the complex measurements to be made in industry, the new catalog contains more than 150 photographs and diagrams and describes the uses, features, specifications, and prices of more than 130 G-E testing and measuring equipments. The new catalog also contains publication references to G-E bulletins that describe each device in more detail.

Horizontal Tank Capacity Chart

A handy chart for quickly figuring the number of gallons of a liquid in any horizontal tank without the use of tables, formulas, or computations is available from Armstrong Machine Works, Three Rivers, Mich. The chart and explanation is printed on an 8½ × 11-in. card suitable for hanging on the wall for quick reference.

Nickel Alloy Steel Castings

A 32-page illustrated bulletin on nickel alloy steel castings has been issued by International Nickel Co., Inc., New York, N. Y. It reports on steel, cast to shape, as a reliable engineering material. Data on properties and applications of cast nickel steels of the constructional grades are classified by industrial fields. Low-temperature properties, abrasion resistance, depth hardening, and welding are discussed. Advantages and recommended specifications and compositions for typical service applications are given.

Torque Control

A new manual compiled at the Laboratory Division of P. A. Sturtevant Co., Addison, Ill., is available as an aid to those persons responsible for torque control specifications and applications. The booklet depicts general principles of torque tools and methods of use.

Packaged Steam Generators

A new catalog issued by York-Shipley, Inc., York, Pa., describes the Steam-Pak Generator. These packaged steam generators are delivered as one integral unit: boiler, burner, firebox, insulation and metal jacket, piping, condensate system, electrical controls, everything completely self-contained.

Surface Evaluation

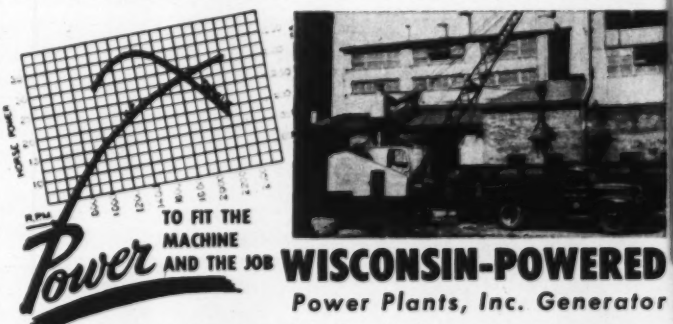
"Surface Evaluation by Faxfilm" is the title of a new 8-page folder describing applications and equipment for Faxfilm. Issued by The Brush Development Co., Cleveland, Ohio, the bulletin points out that Faxfilm is the process which employs a plastic replica to show roughness, wear, grain, and other surface conditions of almost any shape of a wide variety of materials. The folder describes in some detail the applications for inspection and for test and process engineering as well as applications in other fields.

Heat Exchanger

Niagara Blower Co., New York, N. Y., announce a new bulletin, No. 120, covering their Aero Heat Exchanger. It is a simple method of cooling or controlling the temperature of a liquid or gas. The fluid to be cooled is in a closed system free from contamination.

Electric Trucks

A new 12-page bulletin, No. P5151, describing their complete line of electric trucks in capacities from 1000 to 100,000 lb has been prepared by the Philadelphia Div. of the Yale & Towne Mfg. Co. The booklet describes generally, the types of Yale electric trucks available, their features, a table to aid in selection, and application data.



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Power Plants, Inc. Generator

Three carloads of scrap travel fast from freight cars to trucks every day with this crane on the job. It's equipped with a 36" ECM magnet, and the generator, built by Power Plants, Inc., Cleveland, Ohio, is powered by a Wisconsin Air-Cooled Engine.

Over and above time and labor saved through Wisconsin Engine dependability, servicing and maintenance are reduced to a minimum. For example, bearing failure is unheard of due to tapered roller bearings at both ends of crankshaft. Fool-proof air-cooling means no winter freeze-ups or summer overheating. And an easily-serviced OUTSIDE magneto with impulse coupling delivers all-weather quick starts. These features, combined with rugged construction, are the basis for the most dependable, most versatile power in the 3 to 30 hp. range . . . WISCONSIN POWER.

Write for details covering 4-cycle single-cylinder, 2-cylinder and V-type 4-cylinder models.

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World's Largest Builders of Heavy-Duty Air-Cooled Engines

Crescent 4-Way Valves

Barksdale Valves, Los Angeles, Calif., have published comprehensive data in bulletin No. 1046C on the new Crescent valve line. Performance characteristics: continuous fast cycling, up to 600 cpm without over heating. Valves come in 1/4, 3/8, 1/2, and 3/4-in. sizes for single and dual pressure operation on air, water, or light oil from 0 to 150 psi.

Ash Handling

A bulletin, "Modern Ash Handling for Modern Power Plants," recently issued by the Allen-Sherman-Hoff Co., Wynnewood, Pa., shows plants representing the latest in steam-generating engineering and in modern ash and dust handling. In each case, A-S-H engineers and designers have worked out the best combination of methods to fit individual plant conditions.

Vertical Propeller Pumps

A new bulletin No. W-314-B2 on vertical propeller pumps for flood control, drainage, irrigation, and similar low head services is announced by Worthington Pump and Machinery Corp., Harrison, N. J. It contains cross-section drawings, dimensions, and a discussion of recommended clearances for the pumps. A request on company letterhead will bring you a copy of this bulletin.

Steel Shop Equipment

A new folder describing its Hallowell line of steel shop equipment has been prepared by Standard Pressed Steel Co., of Jenkintown, Pa. Included are pictures, details, and shipping weights of Hallowell cabinet benches, work benches, bench legs, drawers, shop desks, cabinets, tool stands, carts, stools, and chairs.

Non-Frosting Gages

Non-Frosting Gages for reading liquid levels accurately in processes involving low-temperature fluids, in the chemical, petroleum, and other process industries, for ammonia, freon, etc., are described in a new bulletin, No. 177, issued by Jerguson Gage & Valve Co., 80 Fellsway, Somerville 45, Mass.

Copper and Copper-Alloy Rods

An illustrated, 24-page publication, No. B-14, on copper and copper-alloy rods for screw machine use is available from The American Brass Co., Waterbury, Conn. This booklet includes physical constants and properties on 46 free cutting and general purpose rods. Also featured: convenient weight tables and conversion factors, plus a ready-reference chart for balancing material costs against production costs.

Expansion Joints

A new catalog, No. 51, is now available from Solar Aircraft Co., San Diego, Calif., covering industrial expansion joints and aircraft bellows. The 40-page booklet is designed to help you select the correct bellows for your application. Data and design information are included.

Limit Switches

Three new bulletins, No. GEA-5704, covering rotating-type, No. GEA-5705 on lever-type, and No. GEA-5707 on track-type limit switches are available from the General Electric Co., Schenectady, N. Y. Each publication contains descriptive and application information, switch ratings, and a number of photographs and dimension drawings.

Electrically Formed Tubes

A new 4-page illustrated folder, titled "Machine Hot-Forms Tubing into Complex Parts," is available from Tube Reducing Corp., Wallington, N. J. It treats the economic advantages of hot-forming complex finished parts in the same plant where the precision-sized tubing is produced. The folder describes the machine, the segmented, three-piece dies it uses, and the variables that determine wall thickness and surface characteristics of the finished parts.

VIBRATION Fatigue Tests
POINT THE WAY TO IMPROVED PRODUCTS

You can be sure if your products pass a vibration fatigue test—substantiates design and construction materials—frequently exposes excessive material. Many things can be learned from tests. A "must" for electronic, aircraft and automotive parts and assemblies. Hundreds in use. Models to handle parts from 10 lbs. to 100 lbs.—choice of vertical or horizontal table movement. Frequencies of 600 to 3,600 v.p.m. Special machines to order. Catalog F contains treatise.

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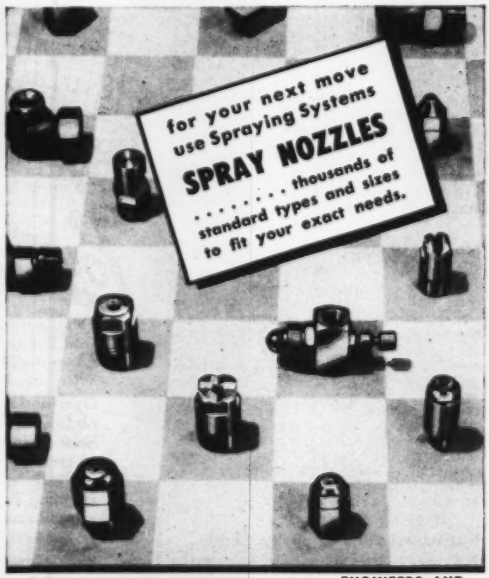
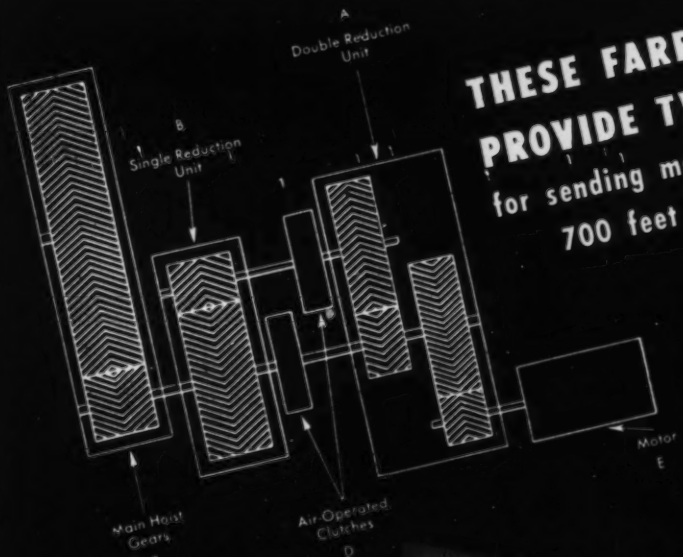


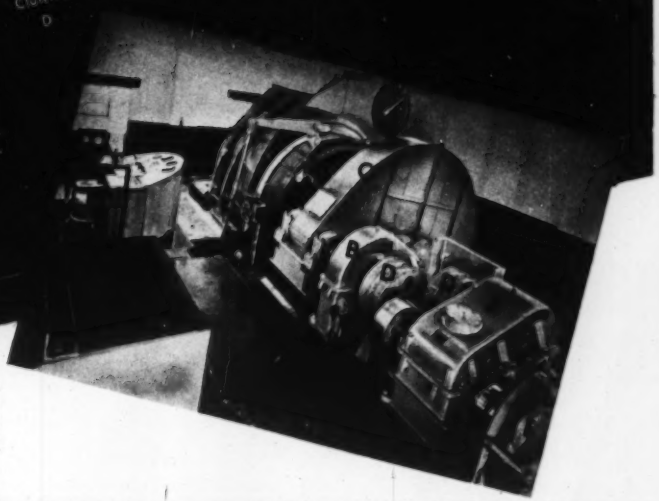
SPRAYING SYSTEMS CO. ENGINEERS AND MANUFACTURERS
3265 Randolph Street Bellwood, Illinois
WRITE FOR General Catalog No. 22 . . . or Pneumatic Atomizing Nozzle Catalog No. 23

THESE FARREL GEARS PROVIDE TWO SPEEDS

for sending men and machines 700 feet underground



Schematic diagram of the Farrel gear drive for the new hoist at Mine 17 of Peabody Coal Company. The hoist was engineered and manufactured by Robert Holmes and Brothers, Inc., of Danville, Ill.



By actuating one or the other of two air-operated clutches, this mine hoist can be run at either of two speeds. For handling machinery at the lower speed, all of the Farrel gears are used to provide a total speed reduction of 144 to 1. For carrying men, the higher hoist speed is used by cutting out the single reduction unit and the second pair of gears of the double reduction unit, giving a speed ratio of 49 to 1.

Farrel-Sykes herringbone gears were selected for this installation because of their quiet, vibration-free performance and long-life dependability — qualities which result from extreme accuracy of tooth spacing, contour and helix angle, and other features inherent in the Farrel-Sykes method of gear generation. These gears are available in any size from ¼ inch to 20 feet diameter, for any application.

A Farrel engineer is ready to assist you in working out unusual gear problems. Why not send for him today?

FARREL-BIRMINGHAM COMPANY, INC. • Ansonia, Connecticut

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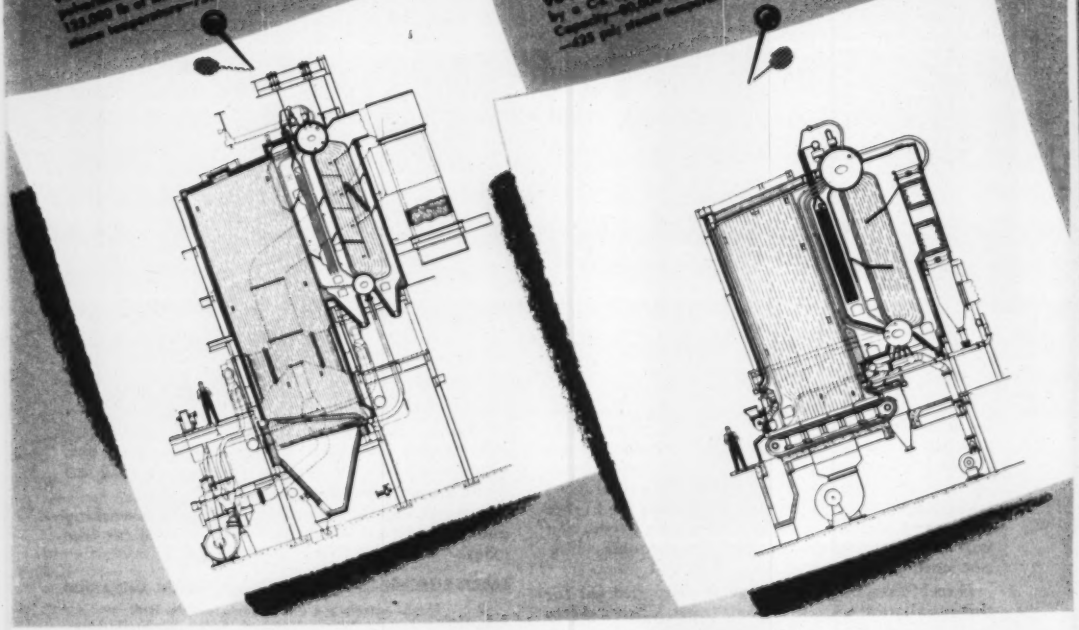
FB-696

How different are your Steam Requirements?

VU installation in a STEEL PLANT. This unit is fired with pulverized coal and/or blast furnace gas. Capacity—132,000 lb of steam per hr; operating pressure—850 psi; steam temperature—750 F.

VU installation in a TOBACCO PLANT. This unit is fired by a C-E Spreader Stoker (overthrow discharge type). Capacity—60,000 lb of steam per hr; operating pressure—435 psi; steam temperature—450 F.



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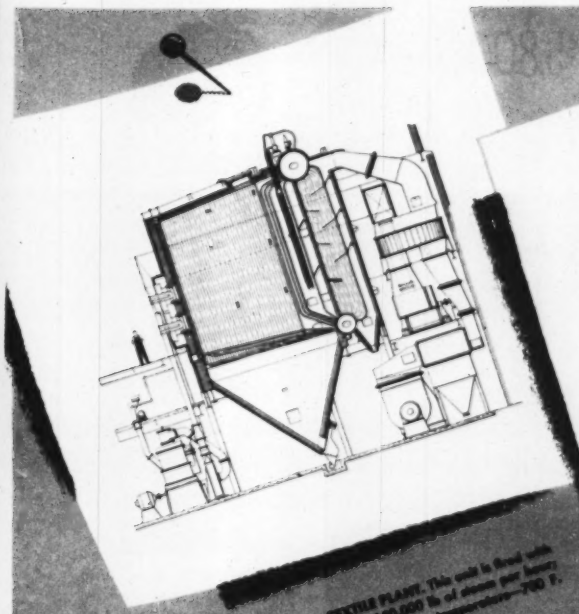
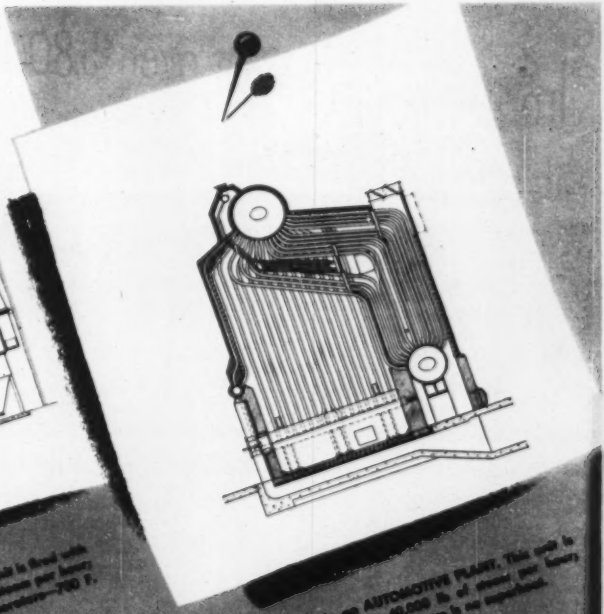
ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS



VU installation is a TEXTILE PLANT. This unit is fired with pulverized coal. Capacity—150,000 lb of steam per hour; operating pressure—600 psi; steam temperature—750 F.



VU installation is an AUTOMOTIVE PLANT. This unit is fired with oil. Capacity—40,000 lb of steam per hour; operating pressure—150 psi. There is no superheat.

Every engineer knows that steam requirements vary from industry to industry . . . from plant to plant. It is virtually certain, therefore, that your particular conditions of fuel, load, capacity, pressure and temperature are not exactly the same as those of any other plant.

Yet the C-E Vertical-Unit Boiler can deliver top performance in your plant . . . just as it has done in hundreds of others . . . representing a wide variety of steam conditions.

This is because the basic design of the VU allows exceptional latitude in the selection of the *right* boiler to fit your particular requirements. It is available in capacities from 10,000 to 350,000 lb of steam per hr, with pressures from 160 to 1000 psi and temperatures up to 900 F, or more. It is adaptable to limited space conditions and to the use of any fuel or method of firing. The VU may be operated over a wide range of output, and, depending on fuels and the use of heat recovery equipment, efficiencies range up to 88%.

How well is the Vertical-Unit Boiler meeting the steam requirements of different industries? The answer is to be found in an impressive record of orders and repeat orders covering virtually every field. If you would like first hand information on the story of the VU Unit in your industry we would be glad to send it to you.

• • •

The point is that the story is the same . . . in industry after industry . . . *the popularity of the C-E Vertical Unit Boiler is widespread and steadily increasing.* Why not investigate how the variables of your requirements can be matched with the VU Unit for top performance?

B-540

— SUPERHEATER, INC.

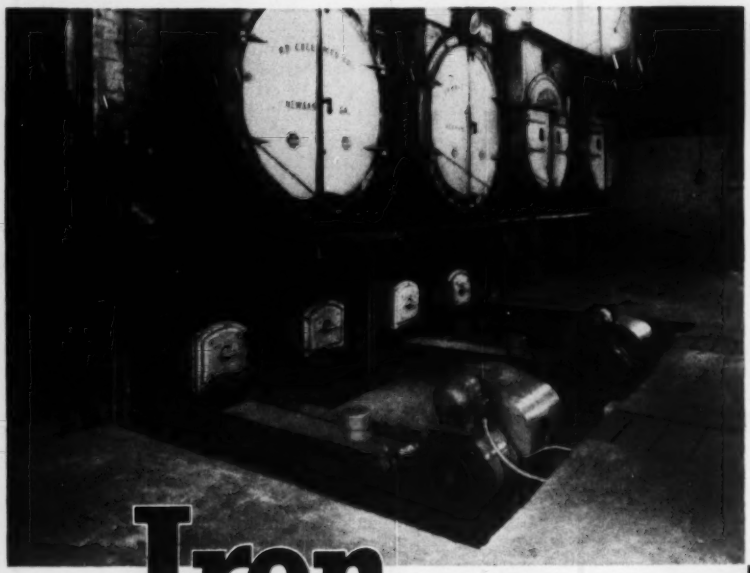
200 MADISON AVENUE, NEW YORK 16, N. Y.

C·E

"Iron Fireman saves over $5,800 a year at Reeves Brothers' Chesnee (S.C.) Mill"

says William C. Ariail, Jr.
Supt. of the Plant

"Firing automatically adjusted to the load gives us peak steam production when needed and eliminates excess firing during low demand," says Mr. Ariail. "Fuel costs dropped from $13,416 to $10,400 a year. Total savings, including labor are $5,805."



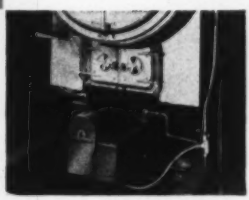
Two Iron Fireman underfeed Coal-Flow stokers in Reeves Brothers textile mill, Chesnee, S. C. Coal is fed directly from main bunkers without manual handling. Steam is used for both heating and processing.

Iron Fireman

The stoker with the modulated fire and built-in coal conveyor

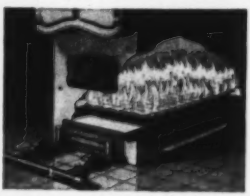
Coal flows automatically from the bunker to the fire, without the cost of manual handling or use of expensive auxilary conveyors. Equally important, its flow is scientifically regulated to provide the exact amount of heat required to maintain the boiler pressures or temperature you require. At the same time the rate of air supply is constantly adjusted to the coal feeding rate.

Important savings are the result of combining this efficient firing with automatic fuel handling. You cannot afford to decide on new firing equipment without considering Iron Fireman.



Iron Fireman Rotary Oil Burner

Fires low-cost, heat-rich heavy oils (No. 5 and No. 6) with complete dependability, regardless of viscosity changes. A real money saver. Capacities up to 500 boiler horsepower.



Iron Fireman Commercial Gas Burner

Vertical type is illustrated above. Others include Radiant Inshot and Ring types. Flexible operation, easy to install. Capacities to 500 boiler horsepower.

MAIL COUPON FOR FULL INFORMATION

IRON FIREMAN MANUFACTURING CO., 3264 W. 106th St., Cleveland 11, Ohio.

Please send literature as checked:

- ☐ Coal-Flow Stoker
- ☐ Rotary Oil Burner
- ☐ Commercial Gas Burner

Name_____

Address_____

City_____

State_____

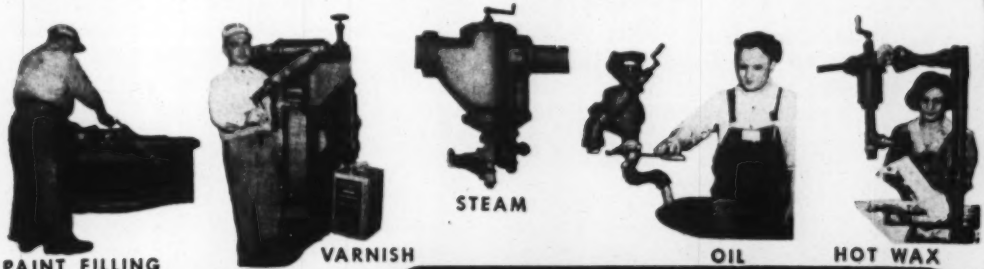
SARCO SCRAPER STRAINERS

—PREVENT WORK STOPPAGES . . . SAVE TIME

The three six inch scraper strainers shown above are insuring a usable water supply 24 hours a day in this busy Detroit paper mill—it is river water which at times is full of debris. Pressure gauges tell the operator when the strainer needs scraping. Then, a few turns of the handles remove all material from the screens and the water pressure becomes normal again.

There are many uses for this Sarco product. Foods and chemicals are run through screens of varying sizes just before packaging. Hot liquids, such as wax and auto frame paint, are purified, and the exhaust steam containing lint from steam hammers is made suitable for use in unit heaters in a large Cleveland metal plant.

Scraper Strainers are available in sizes from ¾" to 8", up to 200 lbs. pressure, hand or motor operated. Bodies, screens and rotors can be made of any metal needed for the application. Ask for Catalog No. 1225.



327

SARCO SAVES STEAM

SARCO COMPANY, INC.
Represented in Principal Cities
Empire State Building, New York 1, N. Y.
SARCO CANADA, LTD., TORONTO 2, ONTARIO

IMPROVES PRODUCT QUALITY AND OUTPUT

ANNOUNCING

New Basic Advances in the complete line of FOXBORO FLOW METERS!

NEW Check Floats with redesigned guides, ball plug and seat. Insure perfect seating every time! Submerged in mercury for complete protection against frosting and fouling.

NEW U-Bend and Damping Plug Assembly. Easy to make up tight every time because of self-aligning all-welded construction. No gasket needed. Replaceable seats. Damping plug fully adjustable under pressure. Directed drain for mercury at lowest point.

NEW Segmental Drive Assembly with stainless steel ball chain that insures free travel of float, and with positive collet-type bearing shaft clamp. Assembly also available in Type 28 Meters with complete ambient temperature compensation —an exclusive new Foxboro feature.

NEW Pressure-Seal Bearing. Revolutionary ring seal gives unequalled freedom from friction, and complete freedom from leaks, at any working pressure. Factory-lubricated—no lubricator required. Shaft and bearing both of Type 316 stainless steel.

NEW Compact Float Chamber gives greater accessibility for easier, quicker cleaning.

All parts freely interchangeable. Easy substitution of range chambers.

FOXBORO . .

REG. U. S. PAT. OFF.

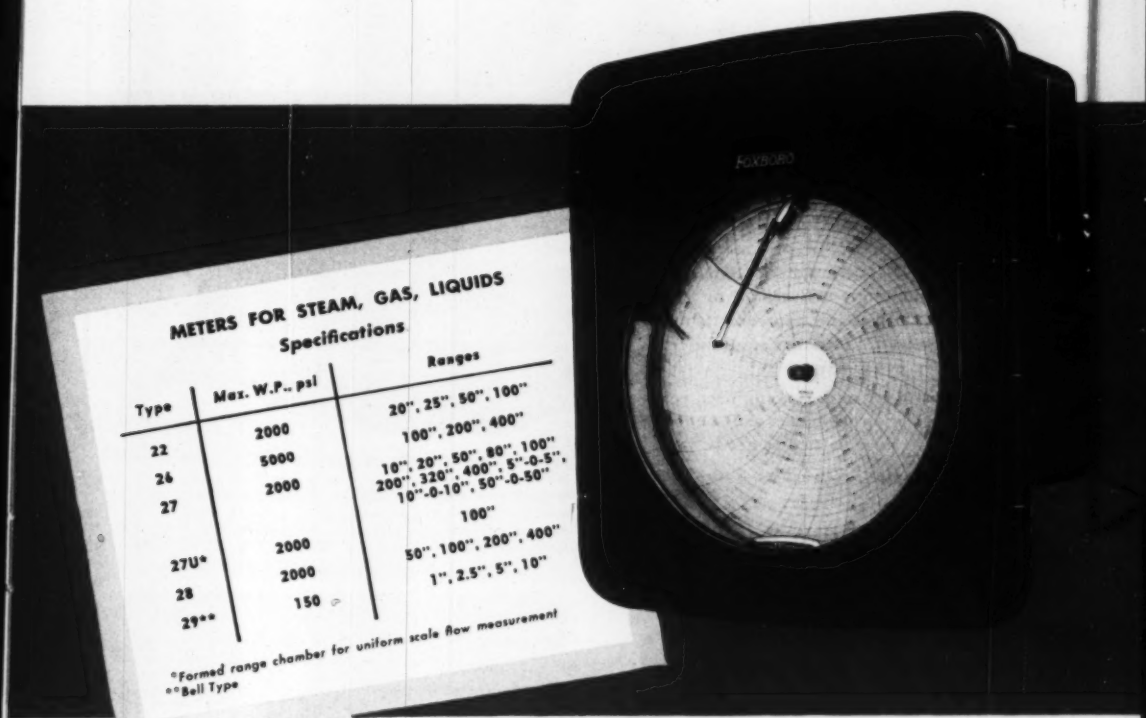
FACTORIES, IN THE UNITED STATES, CANADA AND ENGLAND

Higher sustained accuracy, less maintenance than ever before!

Outstanding improvements in every basic detail of differential meter design now afford a new complete line of Foxboro Flow Meters that set an unprecedented standard of dependable accuracy.

In addition to the important features outlined on the opposite page, these new meters retain all the uniquely advantageous features of the previous Foxboro line, including large floats with long travel for added power; and floats located in high pressure chamber to minimize ambient temperature effects. The combined result is practical metering performance that's farther ahead of the field than ever before . . . in maintenance-freedom as well as sustained accuracy.

Check up on all the advantages of the new Foxboro Flow Meters. Available in round or rectangular cases . . . as indicators, recorders, controllers or transmitters . . . with or without integrators. There's a type for every metering problem. Write for New Bulletin 460. **The Foxboro Company, 1822 Neponset Ave., Foxboro, Mass., U.S.A.**



. . . First in FLOW METERS

Punch press builder insures good lubrication with Farval

FARVAL—*Studies in Centralized Lubrication*
No. 126

ON this Warco press, there are no grease cups. Nothing is left to the judgment of the man with an oil can. The machine is protected by a Farval Centralized System of Lubrication.

Farval makes it routine to see that every bearing regularly gets the exact, measured amount of lubricant it requires. Each work shift, a few strokes of a hand pump lever provide adequate lubrication and keep the press running at top efficiency.

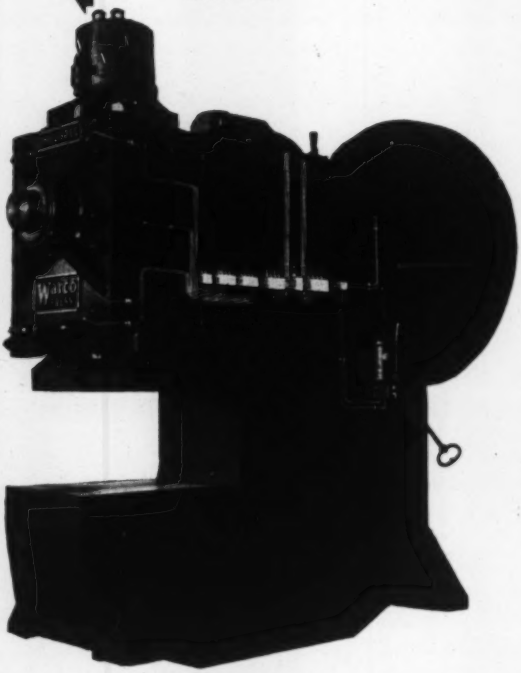
With Farval, special oilers are not needed, lubricant consumption is reduced, bearing life is extended materially and shutdowns for oiling or bearing replacement are eliminated. In short, with Farval on the job, the purchaser of a Warco press is insured of getting all the value built into the machine by its manufacturer.

Farval is the original Dualine system of centralized lubrication for industrial equipment, proved practical in 25 years of service. The Farval valve has only two moving parts — is simple, sure and foolproof, without springs, ball-checks or pinhole ports to cause trouble. Through its full hydraulic operation, the Farval system unfailingly delivers oil or grease to each bearing—as much as you want, exactly measured—as often as desired. Indicators at all bearings show that each valve has functioned.

In or near your city there's a Farval engineer, ready to discuss your lubrication problems and suggest a proper system to meet your particular needs.

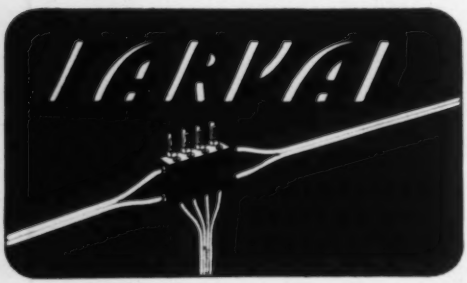
The Farval Corporation, 3264 East 80th Street, Cleveland 4, Ohio.

Affiliate of The Cleveland Worm and Gear Company, Industrial Worm Gearing. In Canada: Peacock Brothers Limited.



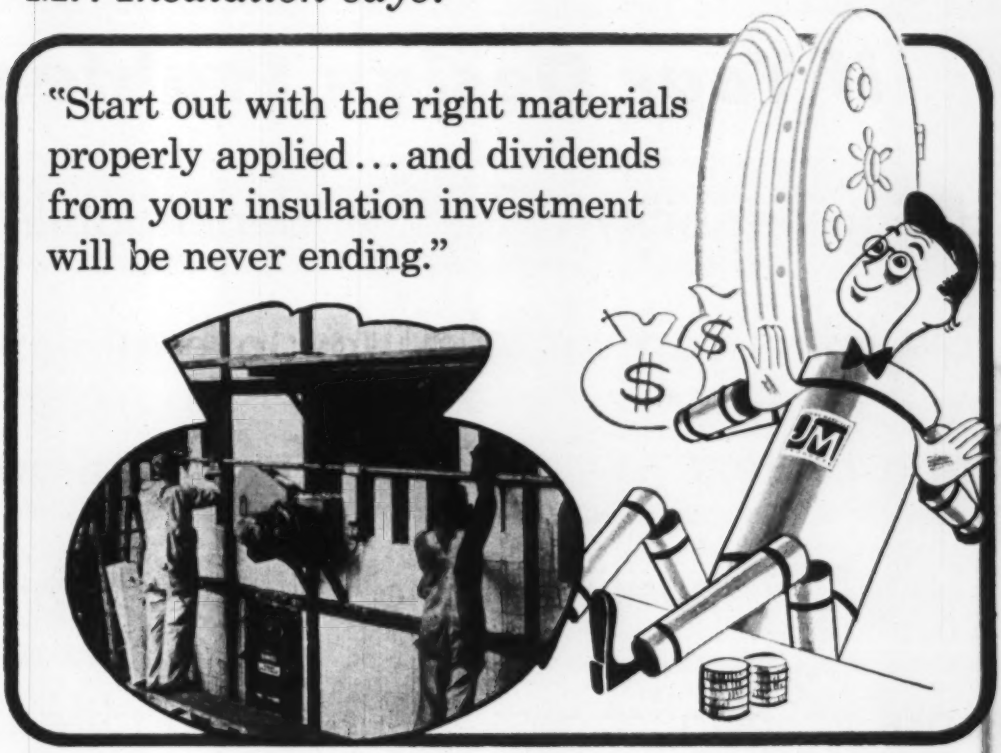
KEYS TO ADEQUATE LUBRICATION—Wherever you see the sign of Farval—the familiar valve manifolds, dual lubricant lines and central pumping station—you know a machine will be properly lubricated. Farval manually operated and automatic systems protect millions of industrial bearings.

Photo above by courtesy Federal Machine and Welder Co.



Mr. Insulation says:

"Start out with the right materials properly applied... and dividends from your insulation investment will be never ending."



Here are two important reasons why it will pay you to let Johns-Manville serve as your insulation headquarters:

YOU GET THE RIGHT MATERIALS—Regardless of the service conditions on your job, Johns-Manville has an insulation that fits the need. That's because Johns-Manville manufactures a wide variety of insulations of asbestos and other selected raw materials—for service from 400F below zero to 3000F above. Johns-Manville offers this complete line because industry requires many types of insulations and because no one material can properly serve as a jack-of-all trades for use on all jobs.

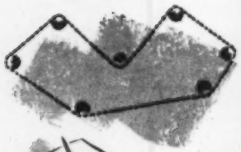
YOU GET THE RIGHT APPLICATION—Insulations serve at top efficiency only when properly applied. J-M Insulation Contract Firms have men with generations of insulation experience and training in Johns-Manville application methods. The way they engineer your job is your assurance that your insulation investment will pay a high return through the years.

Why not call on insulation headquarters for engineering advice about your insulation work. J-M Insulation Engineers are available to help select the *right* insulation for your particular service conditions. Write Johns-Manville, Box 290, New York 16, N.Y.

JM

Johns-Manville *first in* **INSULATIONS**

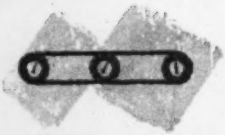
If Your Design Problem

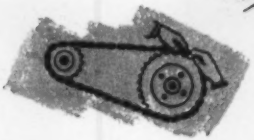
design flexibility  dependability

low initial cost

low overall cost

long centers short

 positive timing heat

ease of installation  long life

Chain Is Your Answer

Yes, chain will solve any of these problems in both drive and conveyor service. The important point is to be sure you select the best chain to do the job. That's why so many designers make their selections from the complete Chain Belt line.

In the complete Chain Belt line there are literally hundreds of sizes and types of chain . . . but only one can be the *best* chain for your particular application. For example: for a high speed drive, Baldwin-Rex® Roller Chain is probably most efficient. For conveying cans, bottles, and jars

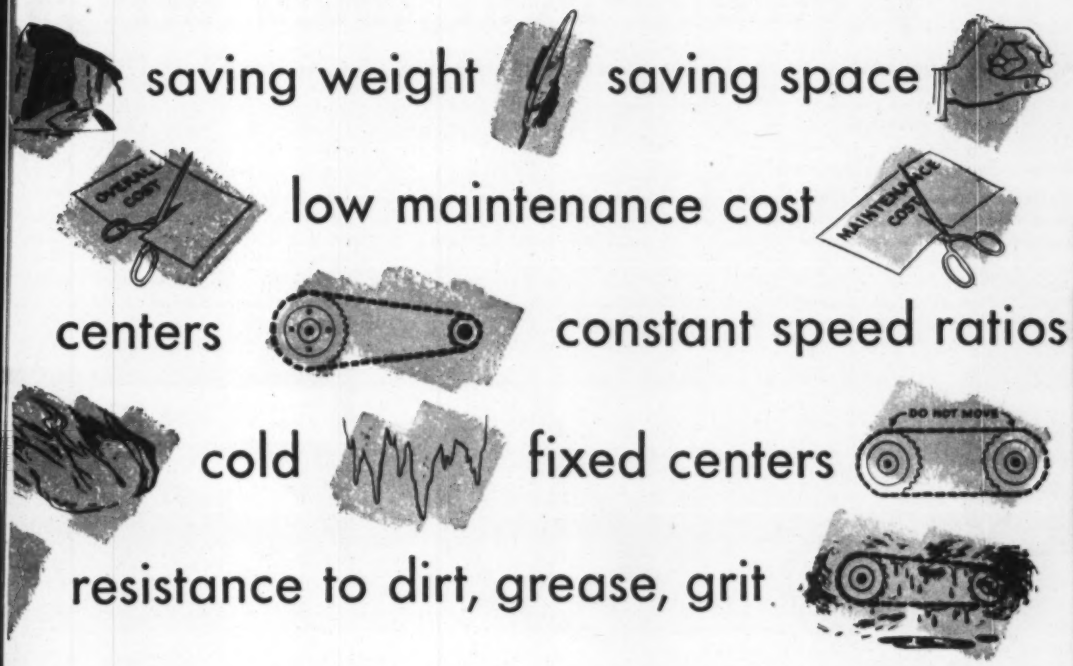
REX

BALDWIN-REX®

Chain

ATLANTA • BIRMINGHAM • BOSTON • BUFFALO
CHICAGO • CINCINNATI • CLEVELAND • DALLAS
DENVER • DETROIT • EL PASO • HOUSTON
INDIANAPOLIS • JACKSONVILLE • KANSAS CITY
LOS ANGELES • LOUISVILLE

Involves...



you choose between Rex TableTop® and Baldwin-Rex PlateTop, depending on load conditions; where loads are heavy and chain must operate in dust and dirt, some type of Rex Chabelco® is usually indicated.

Our Rex Field Sales Engineers are specially trained to help you with your chain selection problems. For more help, call your nearest Chain Belt branch office or write to Chain Belt Company, 4765 W. Greenfield Ave., Milwaukee 1, Wisconsin.

Belt COMPANY
OF MILWAUKEE

MIDLAND, TEXAS • MILWAUKEE • MINNEAPOLIS
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Chain Belt Company 52-101
4765 W. Greenfield Ave.
Milwaukee 1, Wis.
Gentlemen:
My chain selection problem is.....
.....
Please send me appropriate literature.
Name.....
Company..... *Dept*.....
Address.....
City..... *State*.....

Morse ...leading producer of precision-built chain drives

MORSE SILENT CHAIN DRIVES

Industrial type: Morse Industrial Silent Chain Drives are quiet, smooth-running, reliable. They give long years of efficient service with fewer service interruptions.

Automotive type: Morse Automotive Silent Chain Drives are precision-made, mass-produced. The experience and production facilities necessary to supply thousands of these drives daily enable Morse to supply highest-quality, economical industrial drives.

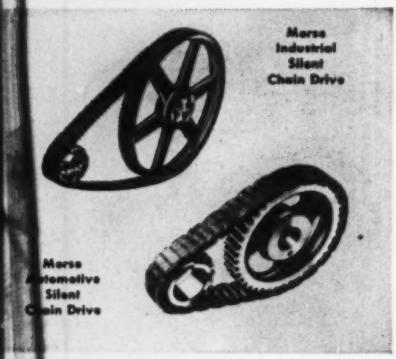
MORSE STANDARD ROLLER CHAIN DRIVES

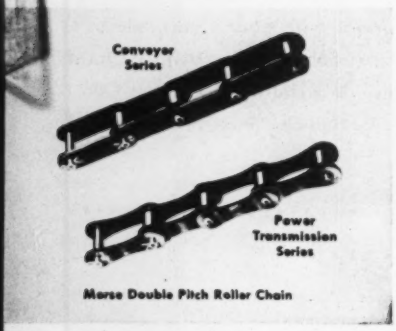
Morse Standard Roller Chain Drives are 99% efficient. They use teeth, not tension; won't slip.

Morse Standard Roller Chains are available from distributors' stock from ¼" pitch to 2½" pitch, with horsepower capacities ranging from less than 1/10 H.P. to extremely heavy horsepower applications using large-pitch, multiple-strand chains. Corresponding sprockets available in types A, B, and C.

MORSE HY-VO DRIVES

Sensational, proved Morse Hy-Vo Drives transmit more horsepower at higher speeds and lower cost than any other standard power transmission drives. They cut operating costs per hour up to 50%, operate 45% more quietly, give up to one-third longer service life. Morse Hy-Vo opens the way to transmitting far more horsepower from smaller, faster engines —without costly outboard bearings and mounts.





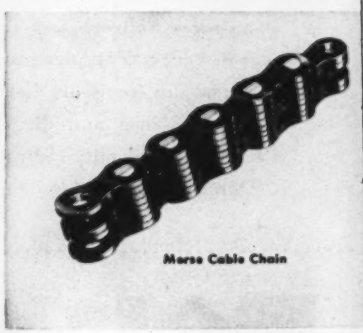
MORSE DOUBLE-PITCH ROLLER CHAINS

Morse Double-Pitch Roller Chains give positive drive. They cost less, weigh less, and give long life comparable to that of standard roller chains. Single and double-duty sprockets available.

MORSE CABLE CHAINS

Precision-built for heavy-duty service. Standard pitches from ½" to 1", with average ultimate breaking strength of from 3900 pounds to 49,000 pounds.

For information on any of these precision-built power transmission chains or chain drives, write Morse direct or phone your Morse distributor.



MORSE CHAIN COMPANY
Dept. 281, 7601 Central Ave. • Detroit 10, Michigan

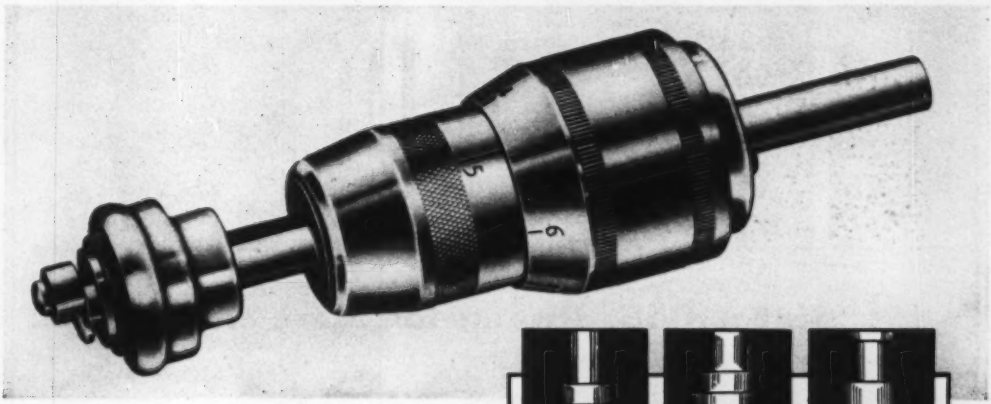
Morse *means* Power Transmission

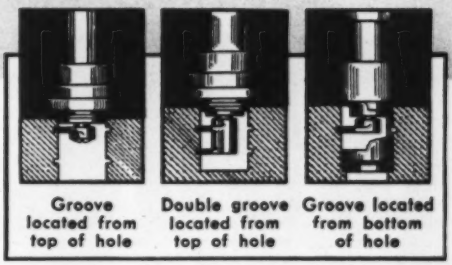
MORSE
MECHANICAL
POWER TRANSMISSION
PRODUCTS
BW

Waldes Truarc Internal Grooving Tool

for precision cutting of internal grooves in bores and housings

FAST! ECONOMICAL! NEEDS NO SKILLED LABOR!





Internal groove-cutting becomes the simplest of operations with Waldes Truarc Internal Grooving Tool. Easy to adjust—easy to operate...readily adaptable to individual requirements.

Designed for use in any hand drill or automatic drill press and screw machine... assures a concentric recess without injury to metal. Operates by fingertip pressure—especially suitable for unskilled operators.

The Waldes Truarc Grooving Tool when used in an electric or pneumatic hand drill, can be taken to the job eliminating disassembly and excessive handling...resulting in all-around savings in time and costs!

Write now for new 12-page Catalog giving mechanical details, cutting sizes...extra features...full information

WALDES

TRUARC

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GROOVING TOOL

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Waldes Truarc Grooving Tool
Manufactured under U. S. Pat. 2,411,426

Waldes Kohinoor, Inc., 47-16 Austel Place
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Please send me your new 12-page Catalog on Waldes Truarc Internal Grooving Tool.

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Company_____

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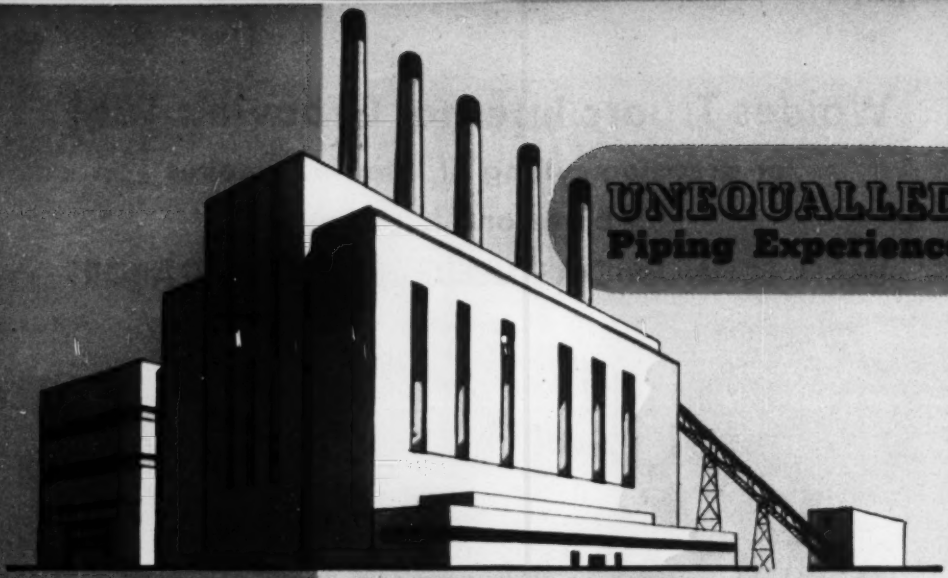

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Piping Experience

Since 1945, Piping for More than

5,580,000 kw

of Central Station Capacity
scattered from Wicasset, Maine to Hawaii
from Grand Forks, North Dakota to Brownsville, Texas

has been fabricated and erected* by . . .

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4 Plants Are Better Than 1

*Including Projects Now Under Construction or on Contract

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PIPING FABRICATORS AND CONTRACTORS

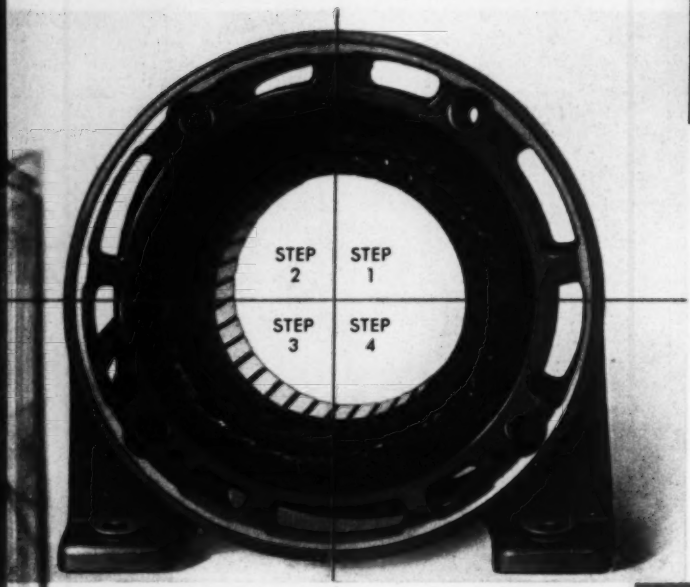
4368

ASBESTOS-PROTECTED!

Asbestos cannot carbonize. That's why all U. S. Motors are asbestos-protected. Life of a motor is proportional to the life of the insulation protecting its windings. In U. S. Motors wires are insulated with asbestos to forever protect them against heat. The exclusive process of insulating U. S. Motors with asbestos insures years of extra motor life and protection against burn-outs.

U. S. MOTORS ASBESTOS-PROTECTED

Avoid this...



INSTALL

U.S.

ASBESTOS PROTECTED MOTORS

WINDINGS GIVEN MULTIPLE TREATMENT

Step by step, everlasting endurance is built into every U.S. motor by use of asbestos, the only natural fibrous element that cannot carbonize. Four progressive treatments of asbestic compounds are applied plus oven-baking, as follows:

STEP 1 — Synthetic insulated wire wound into coils and inserted in slots lined with sheet asbestos.

STEP 2 — Complete stator is submerged in liquid asbestos insulating compound while pulsating current vibrates wires; then baked. A second dip and further baking follows.

STEP 3 — Plastic asbestos compound is sprayed between and over all end turns, then baked to harden throughout.

STEP 4 — Final spray seals pores; after fourth bake the surface contour is smooth.

U. S. Electrical Motors Inc.
Box 2058, Los Angeles 54, Calif. or Milford, Conn.
Send your new Bulletin illustrating and describing U. S. Asbestos-Protected Motors. ☐ Also General Bulletin. ☐

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COMPANY _____

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U.S. ELECTRICAL MOTORS, Inc.

PACIFIC PLANT: Los Angeles 54, Calif. **ATLANTIC PLANT: Milford, Conn.**

Atlanta 3, Ga.; Bakersfield, Calif.; Boston 16, Mass.; Chicago 8, Ill.; Cincinnati 16, Ohio; Cleveland 14, Ohio; Dallas 9, Texas; Detroit 2, Mich.; Fresno 1, Calif.; Houston 4, Texas; Indianapolis 4, Ind.; Milwaukee 2, Wisc.; Minneapolis 2, Minn.; New York City 6, N. Y.; Philadelphia 2, Pa.; Pittsburgh 2, Pa.; San Francisco 7, Calif.; Seattle 4, Wash.
Sales and Service offices in all principal cities.

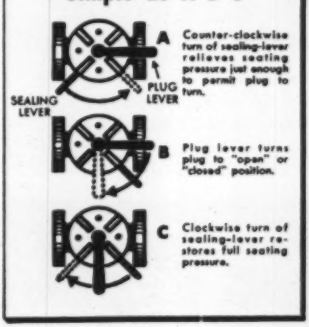
US MOTORS

- **at all times**
- **under all conditions**
- **throughout its long lifetime of service**

This Homestead Valve will always work

it's **stickproof** because it's **lever-seald**

Simple as A-B-C


A
Counter-clockwise turn of sealing-lever relieves seating pressure just enough to permit plug to turn.
SEALING LEVER
PLUG LEVER
B
Plug lever turns plug to "open" or "closed" position.
C
Clockwise turn of sealing-lever restores full seating pressure.

Homestead Lever-Seald Valves operate faster, too—16 to 28 times faster than screw-stem type valves. They require no lubrication . . . provide unobstructed, straight-line fluid flow with minimum pressure drop . . . afford maximum protection to sealing surfaces against corrosive and erosive line fluids. And because only a quarter-turn is needed for full opening or closing, they are ideal for installation in restricted areas where operation of other types of valves might be difficult.

Next time you have damaged or sticking valves, replace them with Homestead Lever-Seald Plug Valves. Once you use them you'll never be satisfied with ordinary valves.

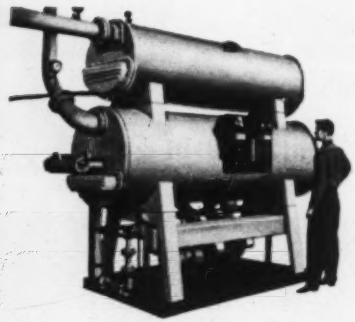
For complete information write for Valve Reference Book No. 39-3.

HOMESTEAD LEVER-SEALD PLUG VALVES

HOMESTEAD VALVE MANUFACTURING COMPANY

Serving since 1892

P.O. BOX 38 CORAOPOLIS, PA.



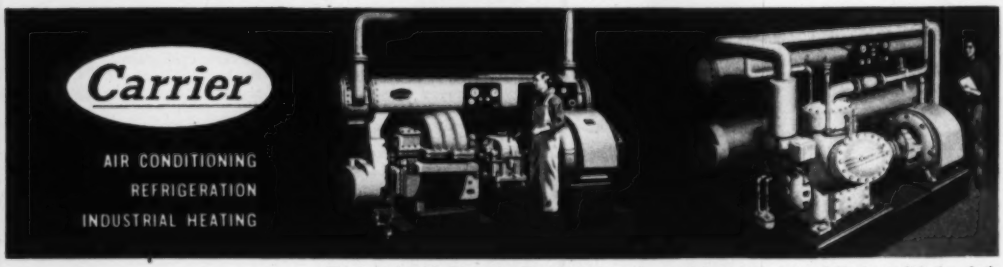
Want to chill water with a lazy boiler?

Maybe you've got a boiler that takes things easy for months at a time. That idle steam capacity could go to work, you know. Providing refrigeration for you — with a Carrier Absorption Machine.

The Carrier Absorption Machine cools with steam by absorption. High pressure steam or low pressure steam. Steam from a boiler that's idle during the summer months. Or even waste steam from other equipment. And its steam rate is less than 20 lbs. per hour per ton. Now, whether for industrial or comfort cooling, economies like that add up in a hurry.

Lots of other advantages too. It's lightweight and compact enough to be put on roofs or intermediate floors without heavy foundations . . . vibrationless enough to fit into critical places like laboratories. Its refrigerant is the cheapest known — water — and its absorbent is safe — a simple salt. Handles partial loads automatically, has no major moving parts, needs no highly skilled personnel. Five sizes, from 115 to 350 tons, easily adapted for multi-unit installations.

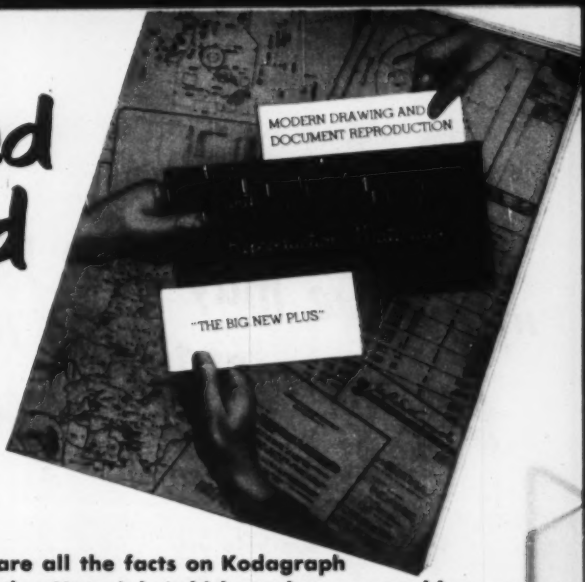
If you heat with a boiler that's idle during the summer months . . . if your gas utility offers low summer rates . . . if you can get cheap natural gas . . . if additional power service is costly . . . this Carrier Absorption Machine may be the most economical installation you can make. You can get full details from the Carrier office nearest you. Or ask for our booklet, "Absorption Refrigerating Machines." Just write Carrier Corporation, Syracuse 1, New York.



The Centrifugal Refrigerating Machine (left) and the packaged Reciprocating Refrigerating Machine (right) also supply chilled water for industrial processes or comfort air conditioning, both offer unique advantages. And *any* Carrier machine carries with it Carrier's experienced service.

Now—revised and enlarged

. . . this free booklet for engineers, draftsmen



. . . here are all the facts on Kodagraph Reproduction Materials (which can be processed by you or your local blueprinter) . . . and the many ways they can cut your drafting-room and print-making costs.

"Modern Drawing and Document Reproduction" is a concisely written, well illustrated booklet which introduces you to the revolutionary line of photographic materials *specifically created by Kodak for use in existing reproduction equipment.* It will enable you to select the right material for the job at hand . . . and duplicate the savings now being realized by thousands of business and industrial concerns.

For example . . . you'll learn about—

- **Kodagraph Autopositive Papers,** *Cloth* and *Film,* which produce positive photographic intermediates directly—without a negative step; *which* can be handled in ordinary room light—exposed in your direct-process or blueprint machine, or vacuum frame . . . and processed in standard photographic solutions.

- **Kodagraph Repro-Negative Paper,** which produces positive photographic intermediates directly from your blueprints, Van Dykes, and other negative originals; and which is exposed and processed in the same fast, convenient manner as the Autopositive materials.

- **Kodagraph Contact Papers and Cloth,** which give remarkable results . . . and simplify print-making in all types of contact photocopying equipment—ending the need for split-second timing and trial-and-error testing.

- **Kodagraph Projection Papers and Cloth,** which enable you to obtain, with your enlarger or process camera, sparkling reproductions from your microfilm or other reduced-scale negatives—"blow-ups" that compare favorably with the originals in legibility.

- **You'll also find** helpful information on Kodagraph Micro-File Equipment designed to meet the microfilming needs of engineering departments, large and small.

Kodagraph Reproduction Materials

"THE BIG NEW PLUS" in engineering drawing reproduction

MAIL COUPON FOR FREE BOOKLET

Eastman Kodak Company, Industrial Photographic Division, Rochester 4, N. Y.

Gentlemen: Please send me a free copy of "Modern Drawing and Document Reproduction"—your booklet that gives the full story of Kodagraph Reproduction Materials. 16

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Company_____

Street_____

City_____ Zone____ State_____

Kodak
TRADE-MARK

"How we may help you get the metal you need"

Maybe we can help you as we did this customer

"Monel sheet was required for a chemical unit. The customer assumed that Monel was not available though it was the metal that would do the job most satisfactorily.

"We, his warehouse, were able to advise him that a CMP rating could be secured for this particular application and the Monel could be had if he would take an extended mill delivery.

"Or, if he could give us a choice of alternate sizes and gauges, it might be available from our warehouse emergency stocks.

"He secured a rating, placed his order and in this case we were able to deliver the Monel sheet in time to meet his requirements."

• • •

And just what kind of help can these Warehouses give you? First, they are suppliers of metals . . . not only Inco Nickel Alloys but other metals as well. They know the availabilities and times needed for delivery.

These Warehouses maintain complete up-to-date information on Government orders and regulations – information that may save you time and trouble in getting the metals you need.

If you have a corrosion problem or require technical assistance on the fabrication or mechanical application of a metal or alloy, they will gladly help you. If they don't already have the necessary information they will get it from the engineering or research staffs at Inco.

WHAT *You* CAN DO:

1. Consult your Warehouse on availability of metals and alloys.

2. Order well in advance of your requirements. Deliveries take longer today.

3. Make certain that your orders carry the D.O. or C.M.P. ratings and in case of Dept. of Defense orders, include contract number.

4. Be sure also to give full and specific "end use" information as evidence of need for N.P.A. approval.

5. Indicate alternate choices on sizes and materials . . . where possible. By so doing a satisfactory alternate often may be obtained more promptly.

6. Depend upon your Warehouse for as much service as possible. Use its existing facilities to eliminate operations in your plant or ask for names of experienced fabricators who can help you.

7. Don't hesitate to ask technical questions about selection, uses and working of Nickel, Monel, Inconel and other critical metals. Often, suggestions can be offered which reduce shop spoilage . . . and save metal.

Very often your Metal Warehouse can help you overcome production difficulties with its on-the-spot knowledge of metals and availabilities. And frequently they can suggest substitute sizes, or in some cases name alternate materials.

All the companies listed here supply Inco Nickel Alloys. Just write to the one nearest you – or better still, pick up the phone and tell them your troubles.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 Wall Street, New York 5, N. Y.

WHAT *We, Your Warehouse,* CAN DO:

1. Advise on N.P.A. requirements, Government regulations.

2. Help metal users solve priority problems and advise on delivery schedules.

3. Help all users of Monel, Nickel, Inconel and other special alloys by giving practical advice on welding, machining, heat treating and other processing methods.

4. Advise on special sizes and shapes in stock which are maintained complete as possible under critical conditions. By suggesting alternate sizes or materials, production can often be kept moving.

5. Help overloaded plant facilities with special services . . . such as cutting, shearing or sawing to size.

6. Mill orders. A close working knowledge of mill conditions enables us to handle mill orders with maximum efficiency. We . . . where possible . . . offer part shipment from warehouse stock.

EMBLEM OF SERVICE

NICKEL INCO ALLOYS

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL • "S"® MONEL
NICKEL • LOW CARBON NICKEL • DURANICKEL® • INCONEL®
INCONEL "X"® • INCOLOY® • NIMONICS

WAREHOUSE AND SERVICE CENTERS

INCO NICKEL ALLOYS

U S., CANADA AND MEXICO

ATLANTA 3—J. M. Tull Metal & Supply Co.
285 Marietta Street, Tel.: Alpine 3871

BALTIMORE 5—Whitehead Metal Products Company, Inc.
4800 E. Monument Street, Tel.: Eastern 3200

BUFFALO 7—Whitehead Metal Products Company, Inc.
2128 Elmwood Avenue, Tel.: Bedford 3100

CAMBRIDGE 39, MASS.—Whitehead Metal Products Co., Inc.
281 Albany Street, Tel.: Trowbridge 6-4680

CHICAGO 33—Steel Sales Corporation
3348 South Pulaski Road, Tel.: Bishop 7-7700

CINCINNATI 29—Williams and Company, Inc.
3231 Fredonia Avenue, Tel.: Capitol 3000

CLEVELAND 14—Williams and Company, Inc.
3700 Perkins Avenue, Tel.: Utah 1-5000

COLUMBUS 8, OHIO—Williams and Company, Inc.
851 Williams Avenue, Tel.: Klondike 1623

DALLAS 9—Metal Goods Corporation
6211 Cedar Springs Road, Tel.: Elmhurst 3271

DENVER 2—Metal Goods Corporation
2425 Walnut Street, Tel.: Acoma 5891

DETROIT 10—Steel Sales Corporation
5151 Wesson Avenue, Tel.: Tyler 6-3000

EDMONTON, ALBERTA—Wilkinson Company, Ltd.
8411 103rd Street, Tel.: 35834

GRAND RAPIDS 2—Steel Sales Corporation
226 Federal Square Bldg., Tel.: Grand Rapids 9-3981

HARRISON, N. J.—Whitehead Metal Products Co., Inc.
1000 South 4th Street, Tel.: Humboldt 5-5000

HOUSTON 3—Metal Goods Corporation
711 Milby Street, Tel.: Central 8881

INDIANAPOLIS 2—Steel Sales Corporation
2059 North Illinois Street, Tel.: Talbot 1506

KANSAS CITY 8, MO.—Steel Sales Corporation
2201 Grand Avenue, Tel.: Victor 7270

LOS ANGELES 21—Pacific Metals Company, Ltd.
1400 South Alameda Street, Tel.: Prospect 0171

MEXICO, MEXICO, D. F.—La Paloma Co. De Metales, S.A.
Mesones No. 33, Apartado No. 7304

MILWAUKEE 9—Steel Sales Corporation
2400 West Cornell Street, Tel.: Hilltop 2-2020

MINNEAPOLIS 13—Steel Sales Corporation
401 Harding Street, N.E., Tel.: Sterling 4838

MONTREAL 1, QUE.—Robert W. Bartram, Limited
455 Craig Street West, Tel.: University 6-3711

NEW HAVEN 13—Whitehead Metal Products Co., Inc.
265 Church Street, Tel.: New Haven 8-0275

NEW ORLEANS 12—Metal Goods Corporation
432 Julia Street, Tel.: Canal 7373

NEW YORK 14—Whitehead Metal Products Co., Inc.
303 West 10th Street, Tel.: Watkins 4-1500

PHILADELPHIA 40—Whitehead Metal Products Co., Inc.
1955 Hunting Park Avenue, Tel.: Baldwin 9-2323

PITTSBURGH 33—Williams and Company, Inc.
901 Pennsylvania Avenue, Tel.: Cedar 1-8600

PORTLAND 12, ORE.—Eagle Metals Company
2336 North Randolph Avenue, Tel.: Tuxedo 5201

ST. LOUIS 10—Steel Sales Corporation
4565 McRee Avenue, Tel.: Grand 5255

SALT LAKE CITY 4—Pacific Metals Company, Ltd.
1186 South Main Street, Tel.: Salt Lake City 8-3421

SAN DIEGO 1—Pacific Metals Company, Ltd.
1533 India Street, Tel.: Franklin 9-5826

SAN FRANCISCO 10—Pacific Metals Company, Ltd.
3100 Nineteenth Street, Tel.: Mission 7-1104

SEATTLE 4—Eagle Metals Company
4755 First Avenue South, Tel.: Lander 9974

SPOKANE 9—Eagle Metals Company
East 320 Trent Avenue, Tel.: Madison 2419

SYRACUSE 4—Whitehead Metal Products Company, Inc.
207 W. Taylor Street, Tel.: Syracuse 3-0158

TOLEDO 2—Williams and Company, Inc.
650 East Woodruff Avenue, Tel.: Adams 8101

TORONTO 5, ONT.—Alloy Metal Sales, Limited
881 Bay Street, Tel.: Princess 2531

TULSA 3—Metal Goods Corporation
302 North Boston Street, Tel.: Tulsa 4-1175

VANCOUVER, B. C.—Wilkinson Company, Ltd.
190 West Second Avenue, Tel.: Fairmount 6101

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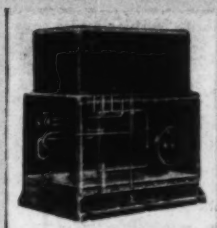
by ERIE CITY

If you use, or plan to use a spreader stoker, investigate modern designs by Erie City. New catalog describes both the *dumping* and *traveling* grate spreaders. They are completely built, erected and tested in our plant to assure smooth field operation. TRAVAGRATE, illustrated above, combines the latest engineering in unit fuel feed and distribution with the simplest, most powerful hydraulic drive on the market. View at the right tells you better than words of TRAVAGRATE'S rugged construction. Remember, Erie City, boiler builders for 111 years, knows steam generation and can help you get the best in boiler-stoker combinations. Outline your steam needs. Write for Spreader Stoker Catalog SB-42G.



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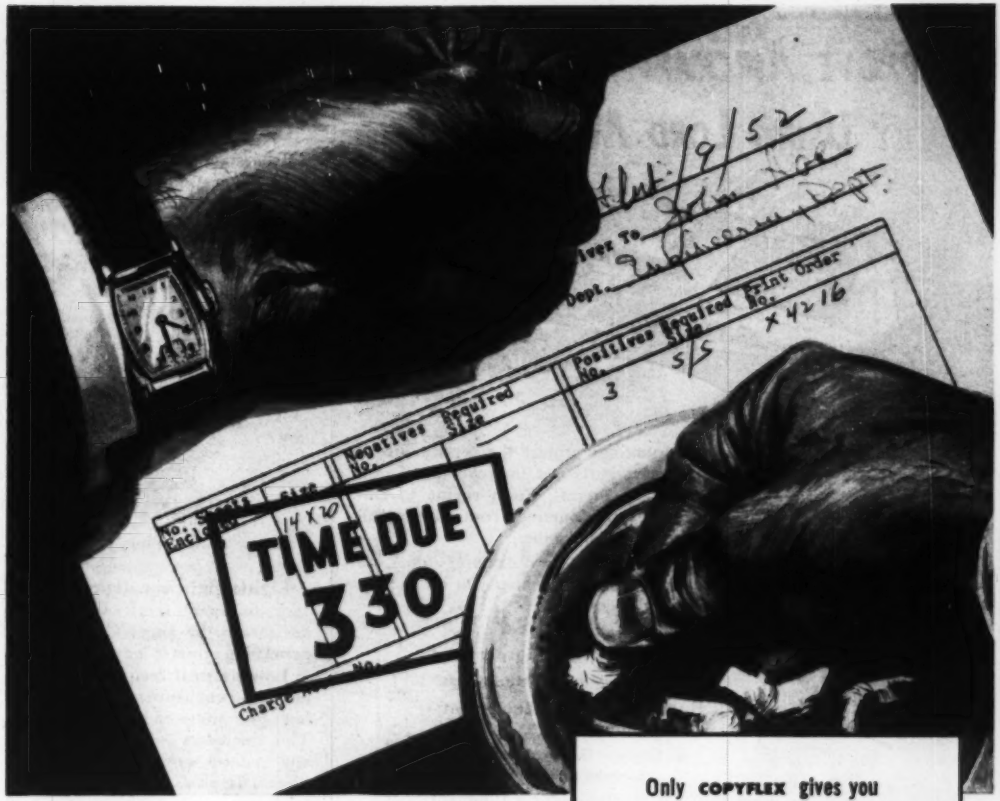
The self-contained hydraulic drive unit is contained in a single housing without external piping. The fluid drive transmits power to the main shaft through a linkage and ratchet gear. A single control valve regulates speed. The drive requires no shear pins since the relief valve opens to protect the equipment should the need arise.

ERIE CITY IRON WORKS *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED and SPREADER STOKERS • PULVERIZERS



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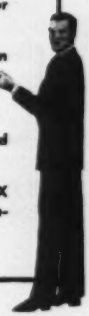
- Wider range of sensitized and coated papers, cloths and films
- Anyone can operate a COPYFLEX machine with a 5-minute explanation



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Specialists in copying since 1897

COPYFLEX 20 handles cut sheets or roll stock up to 42 in. wide. Lowest priced in its class.

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Lord Mountings protect the service life of vital aircraft parts and improve the overall operation of aircraft. From engine to empennage, Lord Mountings contribute a full measure of dependability.

Here are but a few examples of Lord Mountings which may help you on present or future designs:

1. Dynafocal Engine Suspensions
2. Instrument Panel Mountings
3. Communication Equipment Mountings
4. Engine Generator Mountings (For Flying Boats, for Ground Equip.)
5. Photographic Equipment Mountings
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7. Cowl Mountings
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9. Pilot Seat Mountings
10. V. H. F. Antennae Mountings
11. Junction Box Mountings
12. Actuator Attachment Mountings

Take advantage of Lord experience . . . specialists in vibration control for more than a quarter century.

LORD MANUFACTURING CO. ERIE, PA.

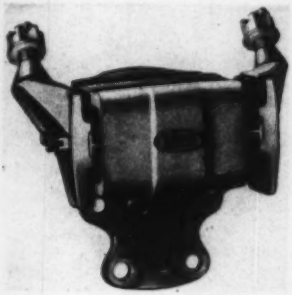
LORD BONDED RUBBER

HEADQUARTERS FOR VIBRATION CONTROL MOUNTINGS . . . BONDED RUBBER PARTS

New Engine Mount Increases Pay Load

A new design Dynafocal aircraft engine mount has been developed by the Lord Manufacturing Company of Erie, Pa. The new mount will be standard equipment on the 1049 Super Constellation.

The unit designated MR-41, employs entirely new structural shapes.



The new design offers these advantages:

Lightweight construction saves 16 pounds per aircraft over previous designs on the Super Constellation, permitting greater payloads.

Low natural frequencies of the mounting enable it to isolate a very high percentage of engine vibration. This increases passenger comfort and reduces crew fatigue on long flights. It also lowers the dynamic stresses imposed upon the airframe structure.

Simplified maintenance results from a considerable reduction in parts. Spare parts inventory is thus materially reduced.

High damping of improved snubbers in each mount prevents metal-to-metal bottoming during periods of abnormal stress.

Basic design features of the MR-41 mount have been thoroughly proved by other engine suspensions developed by Lord for military use.

For a quarter century Lord Designers and Engineers have been solving vibration and shock problems in a variety of industries.

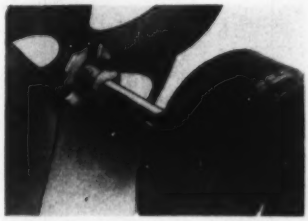
As in the aircraft field, Lord Engineers work closely with original equipment designers in the development of mountings engineered specifically for each particular requirement.

Lord Mountings have become standard equipment on military and commercial aircraft.

Bonded Neoprene Hub Solves Fan Noise Problem

Recently, a prominent manufacturer had produced an attractive and efficient window-type air conditioner. However a high level of motor noise caused purchasers to favor competitive units. Investigation showed that although motor mounts were doing a satisfactory job of isolating motor noise from the cabinet, they did not prevent noise from being carried through the motor shaft into the fan blades and from there into the air stream. It was evident that corrective measures must either prevent the disturbance from reaching the fan blades, or must dampen the vibration of the blades themselves. After several unsatisfactory attempts at redesign, the fan blades were given three heavy coats of paint. This reduced the noise level somewhat. However, the process was expensive and not altogether satisfactory.

The problem was placed with engineers of the Lord Manufacturing Company of Erie, Pa. who specialize in the control of vibration and the production of bonded rubber parts. Within a short time a design for a new hub was submitted for consideration.



The new hub consisted of a stamped aluminum washer and a zinc die casting between which was bonded neoprene of proper stiffness to insure fan stability and maximum vibration isolation. There was no metallic path for vibration to follow, and the neoprene formed a very effective "sound dam" between shaft and fan. Tests determined that motor noise almost entirely disappeared, and operating noise fell to such a low level that even the most critical members of the staff were satisfied. Cost figures proved that the bonded neoprene hub was less expensive than the staked hub previously used plus the three coat paint job on the fan.

THERE IS AN EASY WAY TO CONTROL VIBRATION

The easiest way to solve your vibration problem is to put it up to your nearest Lord Field Engineer. He will analyze it and recommend the specific type of Lord Mounting necessary. By drawing upon complete data files of more than 27,000 Lord Mountings and their variations, it is probable that he can solve your problem from this reservoir of available Lord Mountings.

If your vibration trouble involves circumstances which have not been encountered before, your Lord Field Engineer will work closely with you and with engineers at the Lord Factory to design the type of specific Lord Mounting most profitable to you.

For immediate attention to your problem call or write to

BURBANK, CALIFORNIA
Joe B. Hartley
George E. Behlmer
232 South Third Street
ROckwell 9-2151
CHarleston 6-7481

CHICAGO 11, ILLINOIS
Robert T. Daily
Kenneth L. Hanson
Perry C. Goodspeed, Jr.
520 N. Michigan Ave.
MIchigan 2-6010

DALLAS, TEXAS
Bruce O. Todd
1613 Tower Petroleum Building
PRospect 7996

DAYTON 2, OHIO
W. Webster Dalton
238 Lafayette Street
Michigan 8871

DETROIT 2, MICHIGAN
Everett C. Vallin
7310 Woodward Ave.
TRinity 5-8239

NEW YORK 16, NEW YORK
Vincent Elek
Jack M. Weaver
280 Madison Avenue
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LORD MANUFACTURING COMPANY • ERIE, PA.

LORD — BONDED RUBBER

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VIBRATION CONTROL MOUNTINGS
. . . BONDED RUBBER PARTS

High-speed, high-horsepower drives still running strong after 11 years

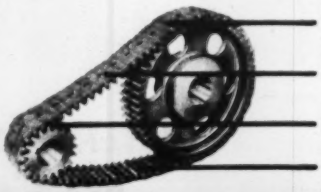
Miami Daily News gets accurate register at 4700 or 3850 ft. per min. chain speeds. Six 100 hp motors are connected through individual Link-Belt Silverstreak Silent Chain and two-speed Herringbone Gear Drives.

LINK-BELT Silverstreak Silent Chain proves low-cost answer to another demanding drive problem

On Jan. 2, 1940, what was then the world's fastest newspaper press began printing the Miami (Fla.) Daily News. Today it's still in use—without a single replacement on its Silverstreak Silent Chain Drives.

And today you'll find Link-Belt Silverstreak Silent Chain doing an efficient, low-cost job on the majority of all high-speed, high-horsepower presses. In fact, wherever a positive, high-speed drive is required, you can rely on Link-Belt Silent Chain.

Remember this—no one chain serves every purpose. That's why Link-Belt builds a complete chain line. No matter what your requirements, Link-Belt offers you the *right* chain to match the specific conditions.



Narrow-width Silverstreak Silent Chain does the job with a *single strand*—eliminating dangers that come with use of multiple belts.

Husky Silverstreak *metal link* construction combines the ability to carry heavy overloads with the resilience that really absorbs shock.

Silverstreak Silent Chain doesn't rely on tension to get pulling power. Chain meshes with teeth—gives POSITIVE drive—no chance for slip.

"Pull" is distributed equally across Silverstreak Chain. No possibility of uneven running—no slapping.

LINK-BELT

One source . . . one responsibility for materials handling and power transmission machinery

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices in principal cities. 12,589

TDA BRAKES

for any job– anywhere–any time

No matter what your braking problem, there is a TDA Brake to do the job. When you equip your product—whether it is an industrial machine or a heavy-duty vehicle—with TDA Brakes, you are guaranteeing your customer safe, sure, dependable braking at bedrock maintenance cost. That's why TDA Brakes are demanded by users of heavy machinery everywhere today—so widely demanded that there are more TDA Brakes in actual operation on heavy-duty commercial vehicles than any other make. This universal acceptance has been honestly earned. For more than 40 years, TDA's engineers have been designing and building brakes to do a superior job for the automotive industry. This experience is your assurance of outstanding performance, whenever you install TDA Brakes.

This air-actuated P Series power brake is ideal for the road-building equipment shown above and for all heavy-duty equipment. It is extremely versatile in itself but is just one of the many great TDA Brakes designed to solve your braking problems, no matter what type of machine or vehicle is involved.

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TDA BRAKE DIVISION
THE TIMKEN DETROIT AXLE COMPANY
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TDA BRAKE DIVISION—DEPT. 48, ASHTABULA, OHIO

Please mail brake information on these applications:

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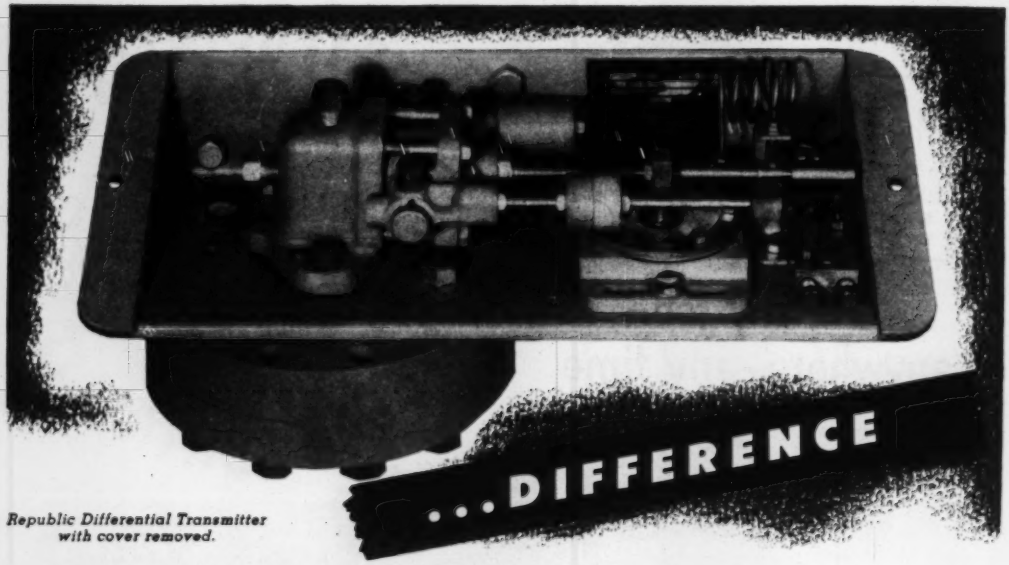


Republic Differential Transmitter with cover removed.

Spells *PLUS* PERFORMANCE

The Republic Pneumatic Transmitter combines machine ruggedness with instrument precision to provide matchless performance in measuring flow, level, pressure or density of a wide variety fluids. By any or all of the following points, the Republic challenges comparison:

ACCURACY of the Republic force-balance principle is higher than can be consistently secured and maintained with any other method. 1/2 of 1% guaranteed.

TEMPERATURE variations of ambient atmosphere have negligible effect on the accuracy of the Republic transmitter.

CHANGES IN AIR SUPPLY PRESSURE do not affect the accuracy of a Republic transmitter to any significant extent. A 5 psi change produces an error of less than 1/10%.

CHANGES IN LINE PRESSURE—Republic differential transmitters are not affected by variations in line pressure. A patented and exclusive simple adjustment assures this protection.

SENSITIVITY—Due to the negligible motions required for complete operation of all parts, for a full scale change, no appreciable hysteresis results from reversal of direction of measurement change.

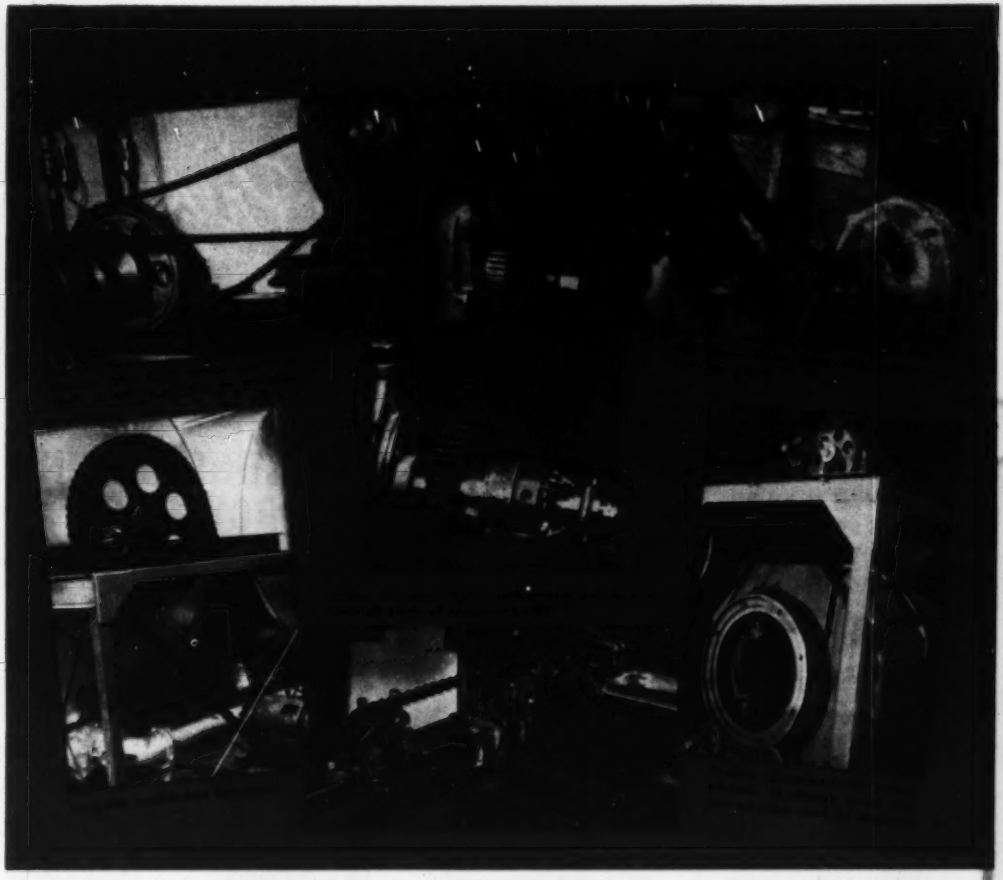
VIBRATION of any normal frequency has no effect on the Republic transmitter.

LEVELING—Since all parts are balanced, and no liquid is used for calibration, Republic transmitters need not be leveled exactly, and may be adjusted for installation in any position.

FOR TWELVE YEARS Republic Pneumatic Transmitters have delivered unmatched performance in every type of installation. Complete details of design and operation, plus numerous application suggestions are combined in Data Book, 1002. Send for your copy, today.

REPUBLIC FLOW METERS CO.

2240 Diversey Parkway, Chicago 47, Illinois



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No Slipping...High Efficiency...Long Useful Life

● Plant men concerned with preventing production delays and holding machinery operations to top levels have followed the example of leading builders of machinery and equipment. They have seen what the long-life reliability of Diamond Roller Chains, their high efficiency and constant speed ratio, non-slipping operation mean under today's strenuous preparedness production programs.

For motor drives, special operations, conveying and timing mechanisms, Diamond Roller Chains are being applied more widely by plant men than ever before.

DIAMOND CHAIN COMPANY, Inc.

Dept. 413, 402 Kentucky Avenue, Indianapolis 7, Indiana

Offices and Distributors in All Principal Cities

Refer to the classified section of your local telephone directory under the heading CHAINS or CHAINS-ROLLER

Just Off the Press!

HERE'S VALUABLE, UP-TO-THE-MINUTE INFORMATION

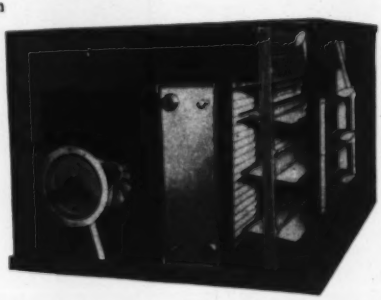
To Help You Solve Your AIR CONDITIONING PROBLEMS!

Write FOR YOUR COPY TODAY

● Here is information on the very latest developments by "Buffalo"—the new model "G" Air Conditioning Cabinets. Bulletin 3703A explains fully, by detail photos, diagrams, charts and tables, what these units can do for you.

You'll be interested in the developments in these new "Buffalo" units. External appearance is clean and modern. The light, efficient "mixed-flow" fans are stable in performance over a wide range of capacities and pressures. Sectionalized construction and standardized parts make for easy installation, simple maintenance and flexibility of combinations. The new model "G" Vertical Type "VPC" Cabinet is in three easy-to-assemble parts — blower head, coil section and pan — easy to move through ordinary building openings — and uses flat type Hi-velocity filters, which greatly reduces the space requirements of the unit. Both Vertical and Horizontal cabinets may be equipped with Air Washer sections, and any air conditioning function or combination of functions can be had.

For helpful information on your air conditioning problems, write today for Bulletin 3703A, on your company letterhead.



"Buffalo" Model "G" Type "PC" Cabinet with side panels removed. Simple cooling, cooling and dehumidifying, heating and humidifying, continuous cleaning — are available functions in these cabinets.

"Buffalo" FIRST FOR FANS

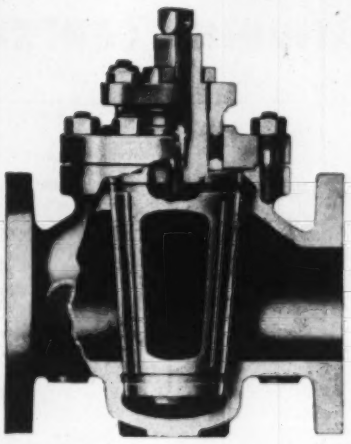
BUFFALO FORGE COMPANY

148 MORTIMER ST. BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

VENTILATING FORCED DRAFT — AIR WASHING COOLING — AIR TEMPERING HEATING — INDUCED DRAFT EXHAUSTING PRESSURE BLOWING

WALWORTH
Lubricated
Plug Valves



for TOUGH assignments

where tight shut-off...
and easy operation
are "MUSTS"

Walworth Lubricated Plug Valves Offer These Advantages

- Complete surrounding of ports with resistant lubricant affords positive seal against leakage.
- Lubricant grooving system assures ease of operation — tight shut-off — greater protection against corrosion.
- Body and plug fully protected by lubricant from attack by line fluids.
- Quarter turn opens or closes valve.
- Made in a complete range of sizes ½" to 26" and for pressures from 175 to 5,000 psi., and for vacuum requirements.

For handling petroleum products, natural or manufactured gas, acids, alkalies, solvents, slimes, slurries . . . in fact for almost any hard-to-handle liquids—there's a Walworth Lubricated Plug Valve designed for the job.

Easy to operate, tight sealing, resistant to wear and corrosion, Walworth Lubricated Plug Valves assure long years of dependable service at low operating cost.

Walworth Lubricated Plug Valves are available in sizes ½" to 26" for pressures from 175 to 5,000 psi., and for vacuum requirements. For full details—prices, sizes, dimensions, and other pertinent data, see your Walworth distributor or write to:

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valves • fittings • pipe wrenches

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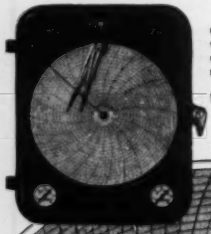
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

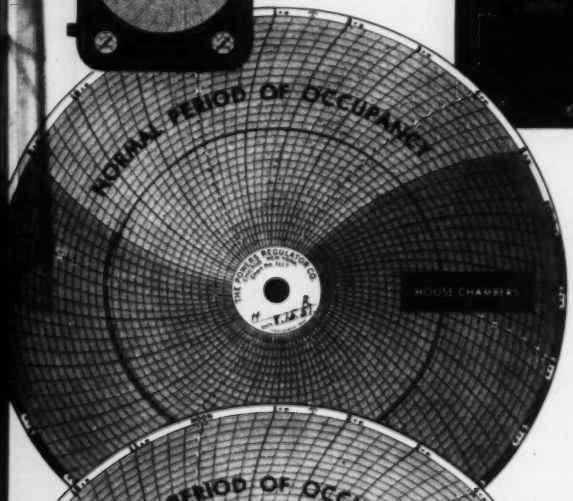
POWERS System of AIR CONDITIONING CONTROL

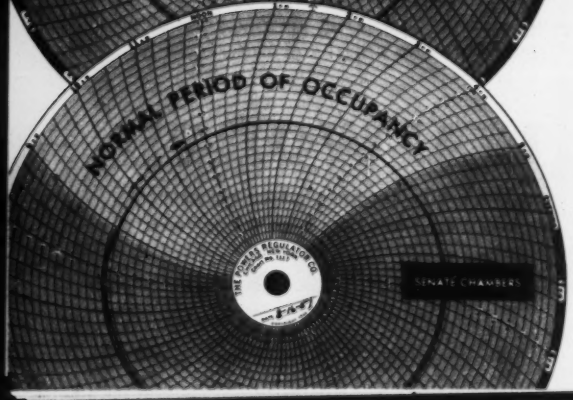
Right: Joint session of the Congress in the recently remodeled House of Representatives—listening to "State of the Union" address by the President.

In the historic House and Senate Chambers as well as the administrative offices in the Capitol, heating and air conditioning systems are regulated by a Powers system of pneumatic control.



Only a few of the many types of Powers Control used in the Capitol are shown here.
Left: Powers Two-pen Recording Controller.





World's Largest and Most Comfortable Legislative Hall is Regulated by—

POWERS AIR CONDITIONING CONTROL

◀ Note Accurate Control in House and Senate Chambers

Outdoor temperatures, during the period covered by the temperature charts varied between 75 and 95° F., yet indoor temperature was maintained constant from 9 A.M. to 5 P.M. One temperature sensitive bulb is located near the speaker's rostrum, another is in the gallery. Note separate lines during the off period of control and how the two lines merge into one when Chambers were occupied.

THE POWERS REGULATOR CO.

3400 OAKTON ST., SKOKIE, ILLINOIS • Offices in Over 50 Cities

Chicago 13, Ill., 3819 N. Ashland Ave. • New York 17, N. Y., 231 E. 46th Street
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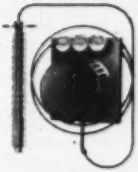
Over 60 Years of Automatic Temperature and Humidity Control

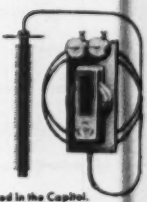
Other Washington Buildings using POWERS Control

Department of Agriculture and Post Office Department Bldgs., Department of Interior and Old House of Representatives Office Bldgs., Social Security R. R. Retirement Bldg., Apex Bldg., Lafayette Bldg., U. S. Navy Hydrographic Bldg., Washington National Airport.

Experience gained by Powers in supplying dependable temperature and humidity regulation for these buildings may be helpful to you. When your problems involve precise control for heating or air conditioning, contact Powers nearest office . . . in over 50 cities.

Powers Room Type Thermostat

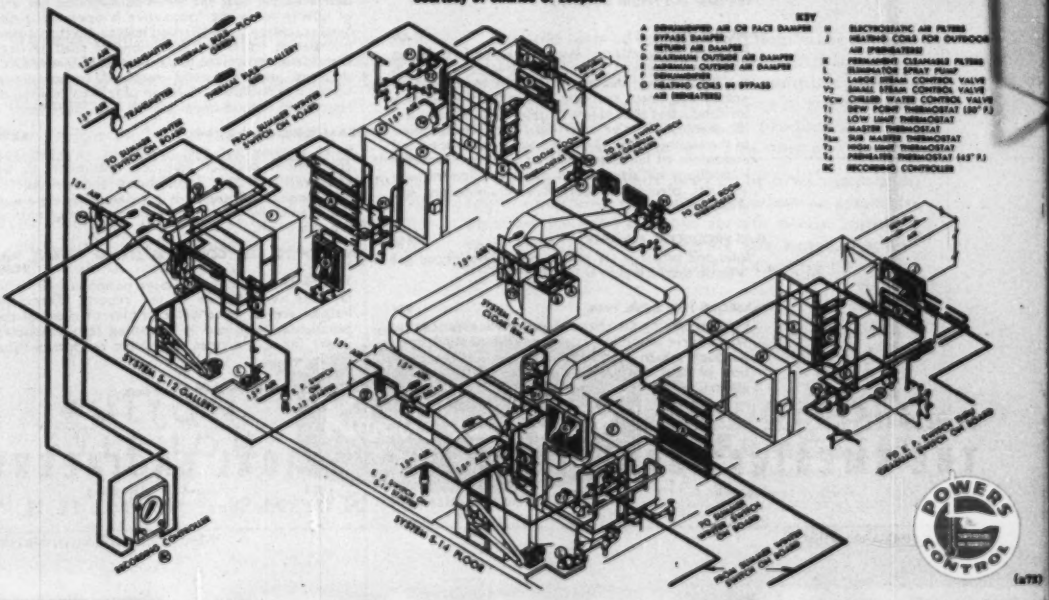




Powers Remote Bulb Thermostats for Dew Point, Low and High Limit, Preheater, Master and Sub-Master Control —only a few of the many controls used in the Capitol.

AIR CONDITIONING APPARATUS DIAGRAM FOR OPERATION AND MAINTENANCE OF SYSTEMS IN THE HOUSE AND SENATE CHAMBERS

Courtesy of Charles S. Leopold


KEY
A DEHUMIDIFIED AIR OR FACE DAMPER
B BYPASS DAMPER
C RETURN AIR DAMPER
D MAXIMUM OUTSIDE AIR DAMPER
E MINIMUM OUTSIDE AIR DAMPER
F DEHUMIDIFIER
G HEATING COILS IN BYPASS AIR (REHEATERS)
H ELECTROSTATIC AIR FILTERS
J HEATING COILS FOR OUTDOOR AIR (PREHEATERS)
K PERMANENT CLEANABLE FILTERS
L ELIMINATOR SPRAY PUMP
V1 LARGE STEAM CONTROL VALVE
V2 SMALL STEAM CONTROL VALVE
Vcw CHILLED WATER CONTROL VALVE
T1 DEW POINT THERMOSTAT (50° F.)
T2 LOW LIMIT THERMOSTAT
Tm MASTER THERMOSTAT
Tsm SUB MASTER THERMOSTAT
T3 HIGH LIMIT THERMOSTAT
T4 PREHEATER THERMOSTAT (45° F.)
RC RECORDING CONTROLLER
TRANSMITTER
THERMAL PAD—FLOOR GRID
THERMAL PAD—GALLERY GRID
TO SUMMER WATER SWITCH ON ROOF
FROM SUMMER WATER SWITCH ON ROOF
TO DOOR OPERATORS
TO DOOR HOLDER MAGNET
SYSTEM S-12 GALLERY
SYSTEM S-14 FLOOR
RECORDING CONTROLLER
TO S. F. SWITCH ON ROOF
FROM SUMMER WATER SWITCH ON ROOF

POWERS CONTROL

(a73)

POWER TEST CODES

Your complete instruction books for determining capacity, efficiency, consumption, and other specified performance of power and heat apparatus

CENTRIFUGAL MIXED-FLOW AND AXIAL FLOW COMPRESSORS AND EXHAUSTERS, Pub. 1949. $1.50

Rules apply to compressors and exhausters including superchargers and axial-flow compressors in which the change in the gas specific weight exceeds seven per cent, and to the testing of apparatus handling gases other than air. Equipment tested in accordance with these rules will reveal one of the following quantities: (a) quantity of air or gas delivered; (b) pressure rise produced; (c) power required for compression and (d) efficiency of the compressor. Required instruments and apparatus are listed and described; instructions are given for making corrections to test performance and reporting tests results.

COAL PULVERIZERS, Pub. 1944. 85¢

Defines practice of testing pulverizers used for firing boiler furnaces, kilns, or industrial furnaces of various types.

DUST SEPARATING APPARATUS, Pub. 1941. 90¢

Designed for testing all types of dust separating apparatus installed for operation in conjunction with solid-fuel fired furnaces in order to determine overall efficiency; efficiency according to size of particles; pressure loss; dust concentration at the inlet and outlet of separator; combustible content of dust entering, leaving, and caught by separator; quantity of gas passing through the separator.

EVAPORATING APPARATUS, Pub. 1941. 60¢

The testing of single- or multiple-effect evaporators according to these rules provides information on: (1) adaptability of apparatus, (2) best method of operation, (3) capacity or efficiency or both of new installation preparatory to acceptance.

FEEDWATER HEATERS, Pub. 1927. 45¢

Rules apply to open and closed boiler feedwater heaters, and with slight modifications to suit special conditions. The Code may apply to heaters for heating water for any purpose when the heating element is either live or exhaust steam. The Code specifies instruments and apparatus required for conducting the tests, and gives directions for reporting the data and results obtained.

FANS, Pub. 1945. $1.00

For conducting tests on blowers, fans, and exhausters of the centrifugal, axial, or mixed-flow types in which the fluid density change through the machine does not exceed seven per cent. Specifies the practice for conducting tests of fans to determine (1) pressure, (2) quantity of air or other gas, (3) power supplied to the fan shaft and (4) efficiency, all under specified conditions of fan speed and air density. Provides instructions for arrangement of test equipment such as ducts, plenum chambers, flow straighteners, and instruments.

GAS PRODUCERS, Pub. 1928. 65¢

Intended primarily for testing producers whose gas is to be used for power purposes.

GASEOUS FUELS, Pub. 1944. 90¢

For determining the chemical and physical properties which serve as indicators of the value of those gaseous fuels which are extensively used in the generation of heat and power, or whose efficiency of utilization is to be ascertained.

HYDRAULIC PRIME MOVERS, Pub. 1949 85¢

Complete instructions for testing an individual reaction or impulse turbine unit of any type. Code provides a check list of items on which agreement should be reached before acceptance; recommendations for making the necessary measurements of power output, effective head, and quantity of water; method of computing and reporting results; and descriptions and definitions of terms used.

INTERNAL COMBUSTION ENGINES, Pub. 1949. $1.50

Designed to meet current requirements for a dependable set of rules for (1) testing all forms of reciprocating internal combustion engines, including gasoline engines, gas engines, and oil or dual fuel engines; (2) the proper evaluation of test results; (3) the instruments, methods, and precautions to be employed.

RECIPROCATING STEAM-DRIVEN DISPLACEMENT PUMPS, Pub. 1949. 80¢

For determining the performance of the pump and engine, including reheaters, heaters and jackets, if any, and jacket pumps, circulating pumps, condensate pumps, and vacuum pumps, which are concerned in their operation.

RECIPROCATING STEAM ENGINES, Pub. 1949. 80¢

Recommends standard testing methods for determining the performance of an engine, including steam jacket if any.

STATIONARY STEAM-GENERATING UNITS, Pub. 1946. 75¢

For testing Stationary Steam-Generating Units defined as combinations of apparatus for producing, furnishing, or recovering heat, together with apparatus for transferring to a working fluid the heat thus made available. Rules show how to conduct tests to determine (a) capacity, (b) efficiency, (c) superheater characteristics, (d) any other operating characteristics. Instructions are given for two acceptable methods of testing for efficiency and capacity: (a) direct measurements of input and output, and (b) direct measurement of heat loss.

STEAM LOCOMOTIVES, Pub. 1941. 65¢

These two sets of rules outline (1) laboratory tests to determine the coal and steam consumption per unit of power when the locomotive is operated under fixed conditions, and (2) road tests to develop similar information under the conditions of road service. Consideration is given to measurements involved, instruments and apparatus required, preparations, operating conditions, duration of test, calculation of results and method of calculating individual items.

STEAM TURBINES, Pub. 1949. $2.00

Rules provide for the testing of all types and applications of steam turbines; instruments to be employed and their applications, and methods of measurement. Instructions for determining the output of an electric generator driven by a steam turbine are also given.

APPENDIX TO TEST CODE FOR STEAM TURBINE, Pub. 1949. $2.00

The information in this 88-page pamphlet will facilitate the working up of test reports. Especially helpful are its numerical examples of many of the calculations involved in reporting tests conducted under the Code rules, and filled-out hypothetical test forms.

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THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

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...Designed for YOU to SAVE for you!

● Whatever your requirements for stainless steel bellows assemblies may be, you can be assured of getting *exactly* what you need from Fulton Sylphon or Bridgeport Thermostat.

We design and engineer assemblies to do specific jobs. For example—for use where there's a design problem involving control of temperature or pressure . . . opening and closing of valves, dampers, etc. . . . absorbing expansion . . . providing packless construction . . . for more uses throughout industry

And add *these* advantages that help make savings for you: Half-a-century of experience in this specialized field . . . skilled personnel . . . complete production facilities . . . ability to produce in any volume. All combine to relieve you of production problems and worries, help save you time and money.

Consult us on your present bellows assemblies requirements—or on any project where an assembly must be designed for your specific needs. Stainless steel or other metals—wide size range. For information, write for idea-filled Catalog CK-1200.

TEMPERATURE CONTROLS

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Knoxville 4, Tenn.

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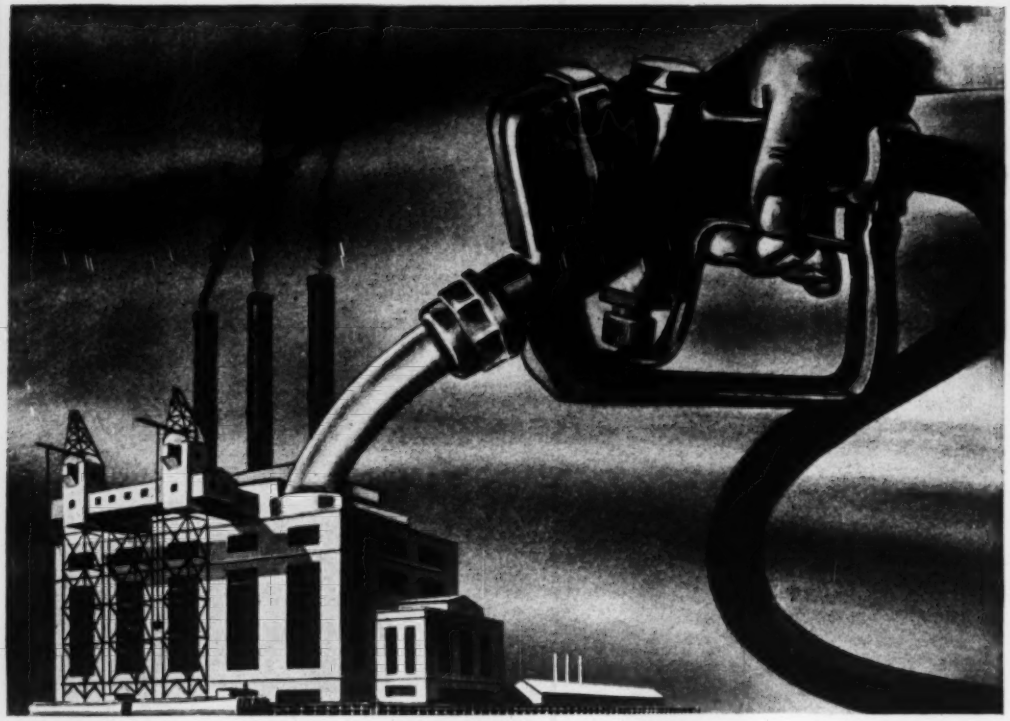
BELLOWS ASSEMBLIES • BELLOWS DEVICES

BRIDGEPORT THERMOSTAT DIVISION
Bridgeport 1, Conn.



Refill For Plants That Need More "Go"

Are increased production loads demanding more than your plant can deliver? Here's how a company we know tackled this problem. The approach used may help you, too.

The demands of a power company called for such increases that a new station was needed. And because the area was so densely populated, tight operating economy was as much a "must" as peak productivity.

The boiler designed to meet these needs was built to deliver over a million pounds of steam an hour. In this design, steam scrubbers and cyclone separators literally cleaned the steam to protect superheaters from impurities that cause overheating and corrosion, and to help turbines keep peak efficiency. By making possible greater water level variations, in addition, this boiler permits larger, faster, *safer* load swings, while other new features assure longer life, lower operating costs, more power.

What *approach* assures equipment advances like these? Combined planning by engineering staffs of progressive Equipment Builders working with process engineers and materials suppliers. And for its knowledge of materials—as well as the design freedom, strength and rigidity of its specialty steel plate, heads and shapes—such builders turn to Lukens regularly.

Would you like them to help you? For their names, write us today, explaining your need. Manager, Marketing Service, Lukens Steel Company, 402 Lukens Building, Coatesville, Pa.

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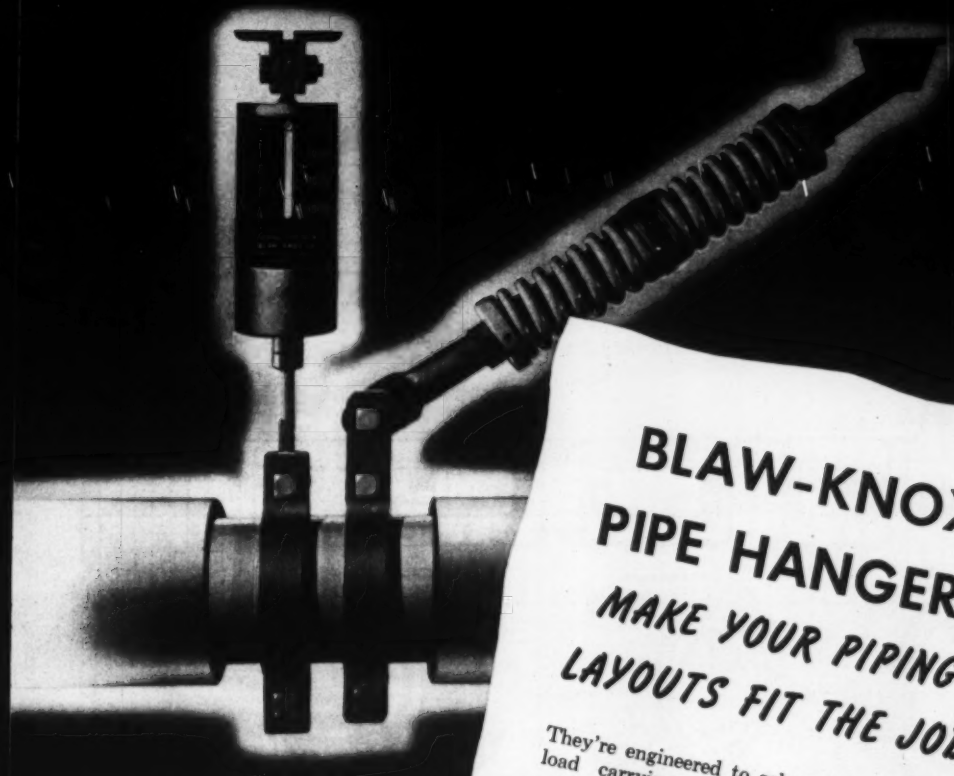
LUKENS STEEL COMPANY

WORLD'S LEADING PRODUCER OF SPECIALTY STEEL PLATE • PLATE SHAPES • HEADS • CLAD STEELS

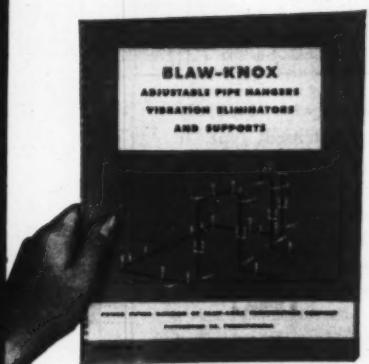


BLAW-KNOX PIPE HANGERS MAKE YOUR PIPING LAYOUTS FIT THE JOB

They're engineered to solve the problems of load carrying . . . vibration . . . misalignment . . . flection . . . expansion and contraction.

Whether you are working with high pressures, normal atmospheres or vacuum, Power Piping offers you engineering advice and installation specialties that assure (1) Joints located in zone of lowest bending movement (2) Reduction in number of joints (3) More desirable flow characteristics (4) Savings in linear feet of pipe (5) Better force and stress relationship . . . in other words, simplified, more efficient piping.

POWER PIPING DIVISION
BLAW-KNOX CONSTRUCTION CO.
PITTSBURGH 33, PA.



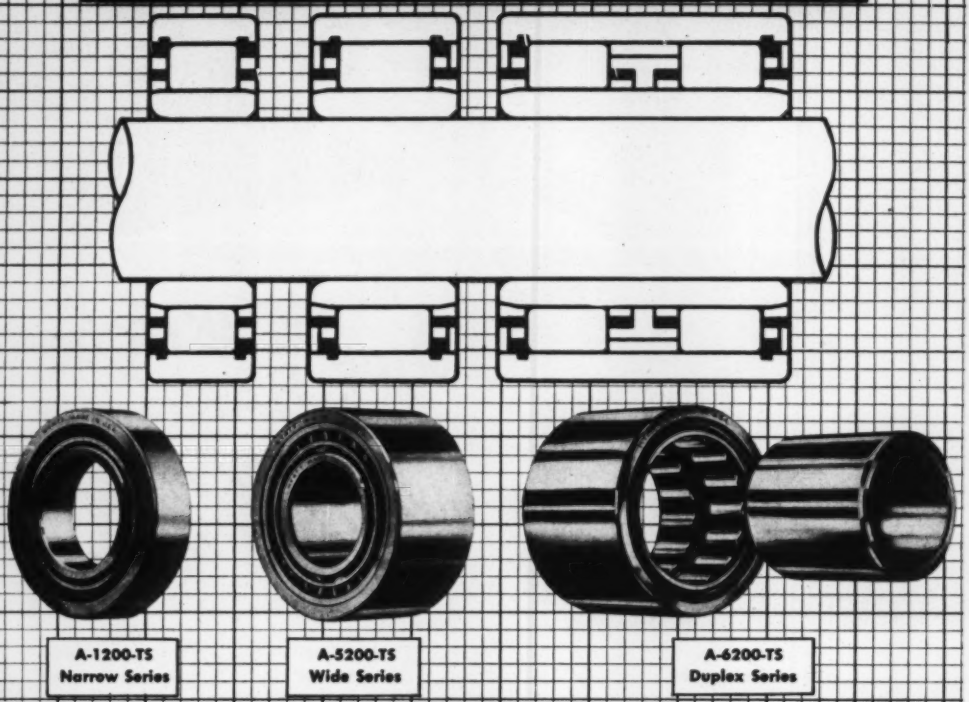
CATALOG NO. 51. *Blaw-Knox Adjustable Pipe Hangers, Vibration Eliminators and Supports was prepared for Heating, Piping and Air Conditioning Engineers exclusively. Technical data and tables will speed your designs and specifications. Please request copy on letterhead.*

BLAW-KNOX

Pioneers in the Development of
FUNCTIONAL HANGERS
VIBRATION ELIMINATORS

For Greater Bearing Capacity—

HYATT HY-LOADS



Where bearing overall dimensions must be kept to a minimum, Hyatt Hy-Load Light Series Roller Bearings are available in three widths to satisfy load requirements and permit wide design range.

As greater load-carrying capacity or longer bearing life is required for a given shaft size and bore diameter, you can go progressively from the narrow, to the wide, or to the duplex series of Hyatt Hy-Load Bearings as illustrated.

When operating speeds are relatively low, greater radial capacity can be obtained in limited space with Hyatt Hy-Loads of the full complement type. In this type of bearing, available in both wide and narrow widths, the roller separators are eliminated, and the maximum number of rollers are employed to provide increased capacity within the same boundary dimensions.

Write for a copy of catalog 547 . . . a complete guide to the selection and use of radial roller bearings. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

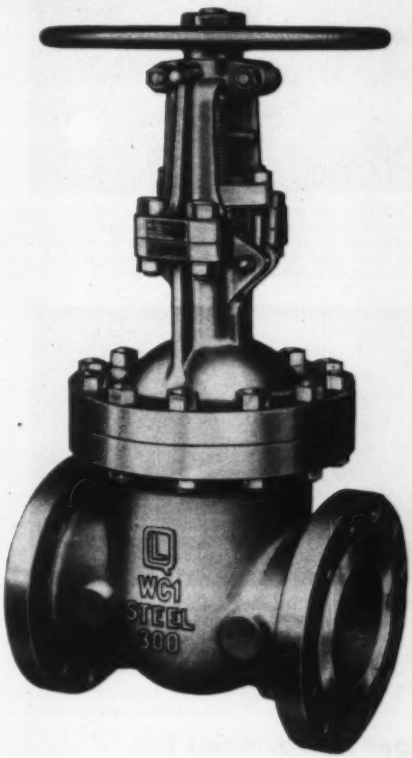
HYATT ROLLER BEARINGS

LUNKENHEIMER
. . . The Steel Valve With A Priceless Ingredient

Into every heat of Lunkenheimer molten steel goes one ingredient that no other valve foundry can duplicate. It's not measured in ounces or pounds — but in generations . . . of tradition. It is pride in the kind of workmanship that has made Lunkenheimer universally respected as the one *great* name in valves.

Engineers are accustomed to dealing in facts — not intangibles. But every realistic engineer knows that molten steel is tricky stuff to handle. It demands *more* from the workman than simple attention. Quality valves—safe valves—are not made by formula alone, but by care . . . interest . . . pride in an unbroken tradition of fine workmanship. At Lunkenheimer, that tradition goes back to 1862.

Lunkenheimer's priceless ingredient will always be intangible, but it can be expressed in terms of one interesting fact: *there is no instance on record where a Lunkenheimer steel valve has ruptured due to defective metal.* For more facts — and for information relating to your specific steel valve application — write immediately to The Lunkenheimer Co., P. O. Box No. 360E, Annex Delivery Station, Cincinnati 14, Ohio.



STEEL • IRON • BRONZE

LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

CAUGHT for heat

Gas Machinery Company

HEAT? Instead of using metal rollers, the manufacturer of this annealing furnace applied a Super Refractory roller-hearth. As a result, the hearth stays straighter, lasts longer, and reduces marking and pick-up.

ABRASION? The skid rails supporting these brass billets were formerly made of alloy. The alloy skids required complete replacement every two to five weeks, constant maintenance between times. When replaced with Super Refractory skids, the new rails required *no attention* for over *three years*.

CORROSION? An interesting application of Super Refractories where no heat is involved is this wire guide. It supports newly drawn steel wire as it passes along the bottom of a tank during zinc coating. It seems to be the only material that will stand up at all under the cutting action of the wire and the corrosive action of the plating solution.

Here's a group of materials often used in place of certain metals—Super Refractories by CARBORUNDUM. Possessing properties seldom associated with refractories, these materials have often proved superior to the metals they replaced; have been invaluable where critical nickel, chrome, or cobalt alloys were involved.

For example, Super Refractories have replaced metals for such diverse applications as: skid rails, muffles, wire guides, radiant tubes, roller hearths, hot blast mains, brazing fixtures, recuperator tubes, etc. In these cases, they not only *released* vitally needed metals but *outperformed* them (by lasting longer than the metals — while also increasing the capacity of the equipment).

As you look over the properties of Super Refractories listed opposite, draw a mental comparison with your needs. Exactly what makes an alloy essential in this place, or that? Is it refractoriness? conductivity? abrasion? corrosion? strength? It's surprising how often you'll find Super Refractories inherently better — and far less expensive — than metals.

It will pay you to investigate these interesting Super Refractories . . . *now*, before the metals cupboard is bare. Won't you write or call us today?

Super Refractories by

CARBORUNDUM

TRADE MARK

Refractories Division

The Carborundum Company, Perth Amboy, N. J.

"Carborundum" is a trademark indicating manufacture by The Carborundum Company

IN THE SQUEEZE resisting metals?

SUPER REFRACTORIES ARE IDEAL WHERE

HIGH HEAT IS INVOLVED. Super Refractories are very strong and durable—can be safely used at temperatures over 3000 F. Compare this with 25-12 chrome-nickel steel, for example, which loses strength rapidly over 1500 F. and cannot be used with safety above approximately 2100 F.

ABRASION OR EROSION ARE PRESENT. Two types of Super Refractories are within one index point of diamond hardness! They are the toughest known materials for large scale commercial use. They will distinctly outwear metals—especially at furnace temperatures.

HEAT CONDUCTIVITY IS NEEDED. At elevated temperatures, one Super Refractory material conducts heat *almost as rapidly as chrome-nickel steels.* It's widely used in equipment involving heat transfer. There are also Super Refractories which are good insulators, particularly at high heats.

STRENGTH IS IMPORTANT. Super Refractories are generally very strong, and *retain* their strength at temperatures where metals become unusable. For example, the modulus of rupture of one composition averages 3100 psi, at 2460 F. No commercial tonnage refractories have greater strength.

CHEMICAL ACTION IS PRESENT. In general, most Super Refractories are either neutral or acid in nature—are widely used where chemical inertness is important.

SPECIAL SHAPES ARE INDICATED. Practically all Super Refractories are available in a wide variety of construction shapes molded to close tolerances—including fitted joints, tubes, etc.

USE THIS BOOKLET TO CHECK UP. This new booklet contains an easy-to-read analysis of the principal characteristics of these unique Super Refractories. The coupon will bring you the story—or one of our engineers will be happy to talk over your problems. We believe it could be mutually profitable.

Dept. P-22
Refractories Div., The Carborundum Co.
Perth Amboy, New Jersey

Please send me your free booklet on the properties of Super Refractories.

Name_____

Position_____

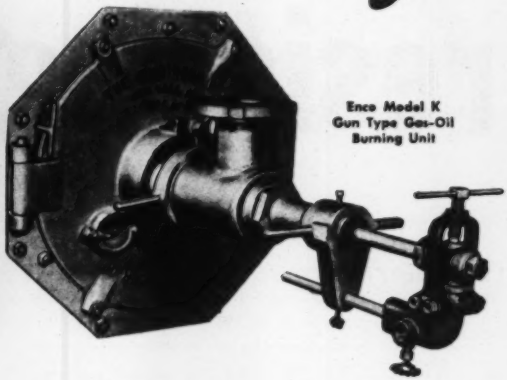
Company_____

Street_____

City_____ Zone_____ State_____

flexible... 3 ways

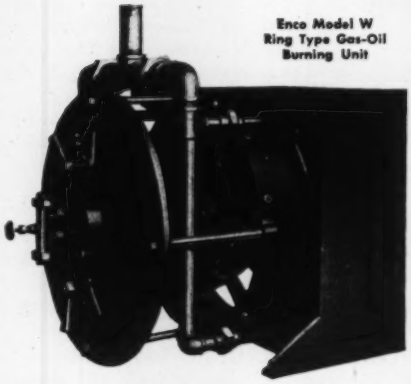
ENCO
OIL AND GAS BURNER UNITS



Enco Model K
Gun Type Gas-Oil
Burning Unit

These specially designed oil and gas burner units fit your needs . . . even when your operating conditions keep changing. Enco Oil and Gas Burner Units offer money-saving flexibility on three important counts. (1) They are designed for use with either oil or gas — or both . (2) They assure completely uniform combustion and greater fuel economy though steam demands swing sharply. (3) They can be operated by either natural or forced draft.

Even if your old combustion equipment "works", it pays to investigate the fuel-saving economies and full flexibility of these highly efficient units. Enco Burner Units are made in many sizes to suit all capacity requirements. Bulletin on request.



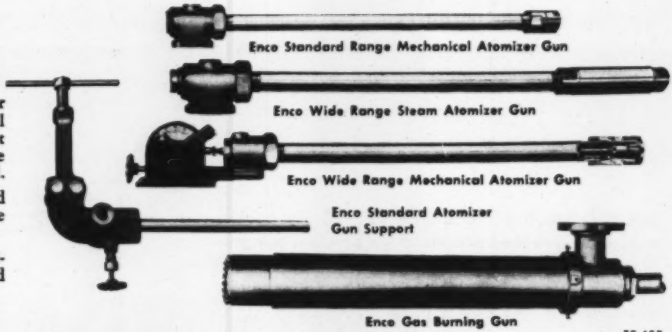
Enco Model W
Ring Type Gas-Oil
Burning Unit

ENCO
INTERCHANGEABLE ATOMIZERS
FOR USE WITH ALL TYPES OF BURNER EQUIPMENT

Wide Range Mechanical—Manual or automatic control. Constant high oil pressure at atomizer insures efficient atomization over entire load range without recirculating or returning oil.

Steam or Air—Wide range. Controlled by manual or automatic pressure regulation.

Standard Range Mechanical — Available in all sizes to suit load and capacity requirements.



Enco Standard Range Mechanical Atomizer Gun

Enco Wide Range Steam Atomizer Gun

Enco Wide Range Mechanical Atomizer Gun

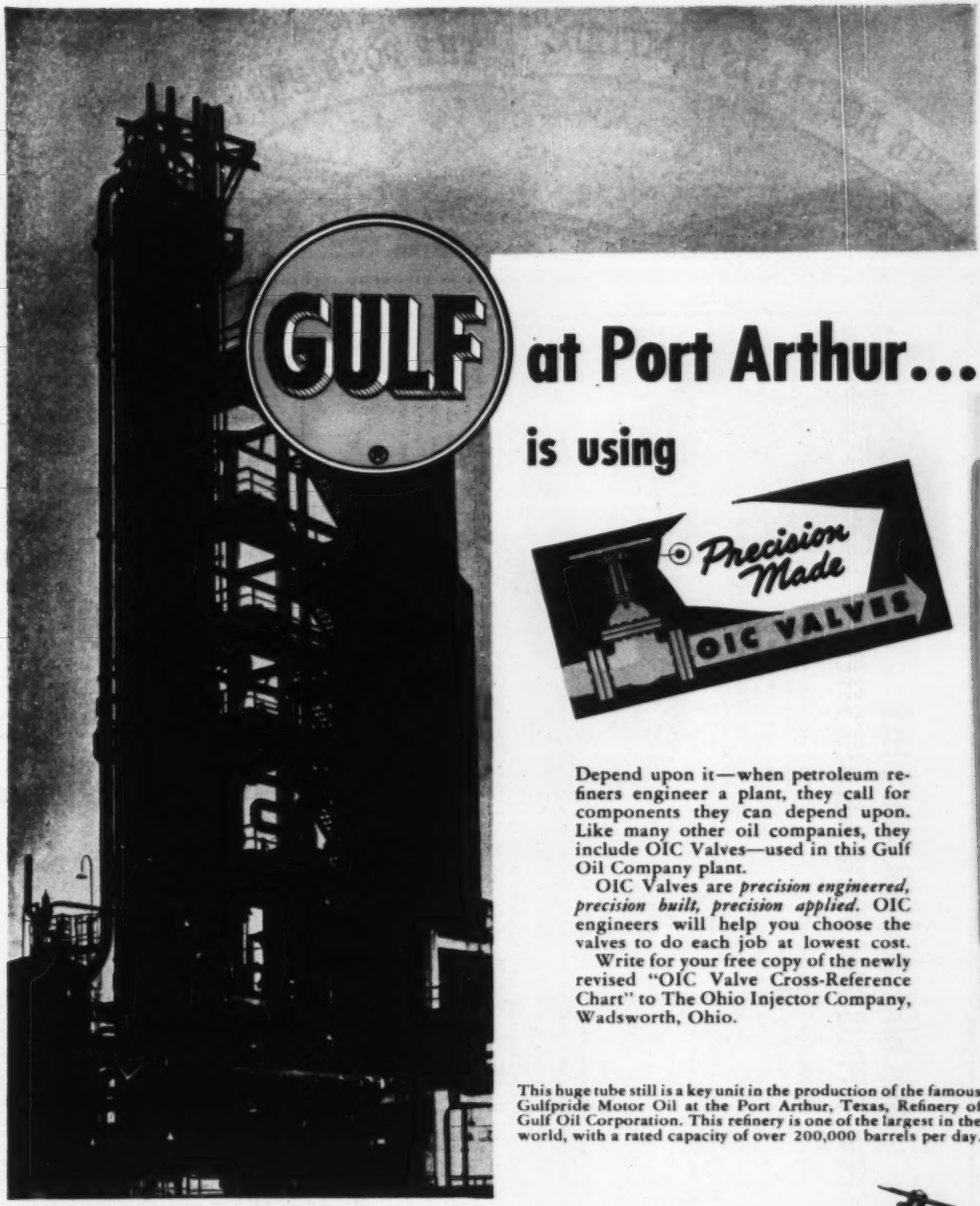
Enco Standard Atomizer Gun Support

Enco Gas Burning Gun

EC-483

THE ENGINEER COMPANY 75 WEST STREET, NEW YORK 6, NEW YORK

IN CANADA: F. J. RASKIN, LTD., 4220 IBERVILLE ST., MONTREAL 34 P.Q.



GULF at Port Arthur...

is using

Depend upon it—when petroleum refiners engineer a plant, they call for components they can depend upon. Like many other oil companies, they include OIC Valves—used in this Gulf Oil Company plant.

OIC Valves are *precision engineered, precision built, precision applied.* OIC engineers will help you choose the valves to do each job at lowest cost.

Write for your free copy of the newly revised "OIC Valve Cross-Reference Chart" to The Ohio Injector Company, Wadsworth, Ohio.

This huge tube still is a key unit in the production of the famous Gulfpride Motor Oil at the Port Arthur, Texas, Refinery of Gulf Oil Corporation. This refinery is one of the largest in the world, with a rated capacity of over 200,000 barrels per day.

OIC
FOUNDED 1881

VALVES

FORGED AND CAST STEEL · IRON · BRONZE

NEW LINCOLN PLANT CREATED BY INCENTIVE-INSPIRED CO-ACTION IN DEVELOPING POSSIBILITIES IN PRODUCT

© LE Co. 1951

MACHINE BUILDER SIMPLIFIES SERVICE PROBLEMS WITH WELDED STEEL

By **Walter E. Vuchnich**
Welding Engineer
Milwaukee, Wisconsin

IN the original design of the side frame member (Fig. 3), service replacement of babbitt bearings for cross shafts required extensive disassembly of the machine. With the welded design (Fig. 4), however, it is now possible to utilize self-aligning roller bearings held in retainers that are simply bolted to the side frame member. All servicing can be done on the job with minimum down time.

The present welded design also affords other important benefits in manufacture. 49% less metal is needed. What little machining is necessary is done on light, fast machine tools. Shop assembly is simpler and can be done with fewer man-hours.

The shop cost of the welded steel frame is 21% less than that of the original construction.

Fig. 3—Original construction *of side frame member weighed 4° pounds and required larger machine tools for boring the retainers for babbitt bearings.*

Fig. 4—Present welded steel design. *Side members are formed from sheet steel. Individual retainers for self-aligning bearings are held to sides with three bolts. Photos courtesy The Fox River Tractor Company, Appleton, Wisconsin.*

PROPER DESIGN IN WELDED STEEL ALWAYS IMPROVES PRODUCT AND LOWERS COST

Fig. 1—Original design *of machine feeder roll required 63 pounds of iron.*

STRONGER, MORE RUGGED

Fig. 2—Weldesign in steel takes 55% less material. *Costs 45% less to build. Eliminates former breakage in service.*

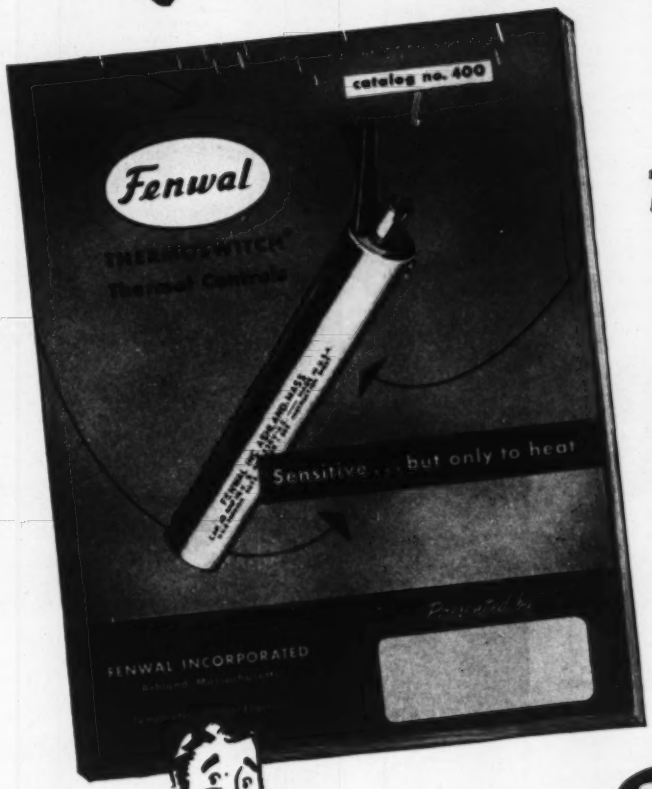
HERE'S MORE PROOF

Machine Design Sheets are available to designers and engineers. Simply write on your letterhead to Dept 401

THE LINCOLN ELECTRIC COMPANY
CLEVELAND 17, OHIO

Get the inside facts

on unique, multi-purpose THERMOSWITCH® thermostat



This New Catalog

explains superior principle of temperature control that results in:

- High sensitivity, high load carrying capacity, low thermal lag, and wide adjustment range
- Complete enclosure against dust and dirt
- High resistance against shock and vibration
- Low cost and ease of installation

CONTAINS—

- Detailed specifications of all types of THERMOSWITCH units
- Complete discussion on proper methods of installing temperature controls
- Price List included with each catalog

MAIL COUPON TODAY!

Fenwal

THERMOSWITCH®

Precision, Multi-Purpose, Thermostat Controls

SENSITIVE... *but only to heat*

FREE! **Get this Catalog . . . see what Fenwal THERMOSWITCH units can do for you. *Just fill in coupon and mail . . . no obligation.***

FENWAL, INCORPORATED, 52 Pleasant St., Ashland, Mass. • Los Angeles, Cal.

ELECTRIC TEMPERATURE CONTROL AND DETECTION DEVICES

Name..... Position.....

Company.....

Street.....

City..... Zone..... State.....

Captain Raymond Harvey Medal of Honor

THE 17TH INFANTRY REGIMENT was attacking Hill 1232 near Taemi-Doug, Korea. Able and Baker Companies became split by a Red-held ridge. Charlie Company, Captain Harvey commanding, was moving up to fill the gap when the dug-in Red guns pinned it down. Calling for covering fire, Captain Harvey advanced

alone through a hail of enemy bullets. One by one, he personally wiped out four emplacements of machine guns and automatic weapons. Then he caught a bullet through the lung. But he stayed on, refusing evacuation, until sure the objective had been won.

"In Korea," says Captain Harvey, "we stopped aggression by *united* strength. *You* were helping—every time you bought a Defense Bond. Because your Defense Bonds were doing more than just helping keep you, and your family, and your country financially stable. They were backing *us* up in the field with *American production power*, the surest support any fighting man can have!

"I hope you'll go on buying Bonds—many, many of them. For your Bonds—and our bayonets—are making America strong. And in today's cold-warring world, *peace is only for the strong.*"

★ ★ ★

Remember that when you're buying bonds for national defense, you're also building a personal reserve of cash savings. Remember, too, that if you don't save *regularly*, you generally don't save at all. Money you take home usually is money spent. So sign up today in the Payroll Savings Plan where you work, or the Bond-A-Month Plan where you bank. For your country's security, and your own, buy U.S. Defense Bonds now!

Peace is for the strong...
Buy U S Defense Bonds now!

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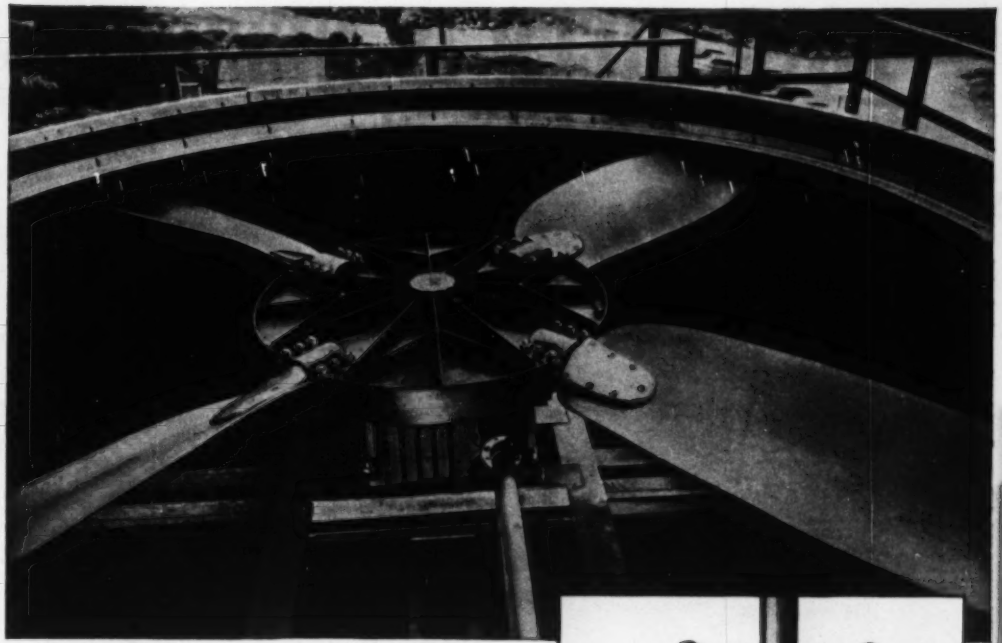
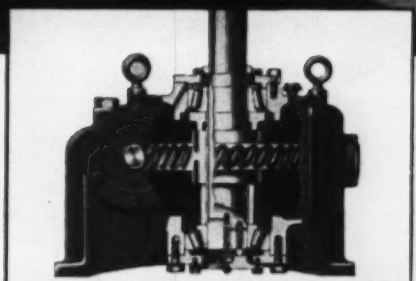


Takes punishment outside because...



...IT HAS THIS INSIDE

Whether the weather is tame or terrible, this De Laval worm gear speed reducer stays in action. Day-in, day-out, it keeps driving the fan of the cooling tower because – feature for feature — this De Laval unit is designed to take punishment under the most rugged conditions. • Take a good look at the De Laval design detailed at right. You will see why it rates high on dependability, long on service. Whatever you manufacture — if you use speed reducers — remember that De Laval Speed Reducers are . . .

Built To Be Built-Into A Quality Product

- **Oil reservoir on top bearing insures continuous lubrication . . . eliminates dry starting after shutdown periods . . . stops rust and corrosion.**
- **A simple, positive displacement pump provides forced lubrication to upper bearing. Design of gearing and oil pump permits reverse operation for de-icing.**
- **Water slinger prevents accumulation of moisture around shaft.**
- **Close-fitting oil seal keeps moisture out of bearing.**
- **Gear shaft bearings amply proportioned to handle unbalanced loads.**
- **Roller bearing specially selected to carry heavy downward thrust load.**
- **Integrally-cast fins, parallel to air flow, aid cooling Bottom of casing is heavily ribbed to prevent distortion from heavy fan loads.**
- **Every De Laval worm gear speed reducer is factory-tested before shipment.**

DE LAVAL *Speed Reducers*

DE LAVAL STEAM TURBINE COMPANY • TRENTON 2, NEW JERSEY

DL 110

YOUR HELP IS NEEDED

to get in the

DORMANT SCRAP

At current steel production rates, 50% MORE SCRAP is needed than in the peak year of World War II. The shortage is so real that steel company representatives are calling on every company in the country to find ways of relieving the situation.

Here's How YOU can help

1. **Take a fresh look at your own plant scrap and salvage activities.**
2. **Call in your dealer—sell your scrap—*NOW!***

WAD 3886

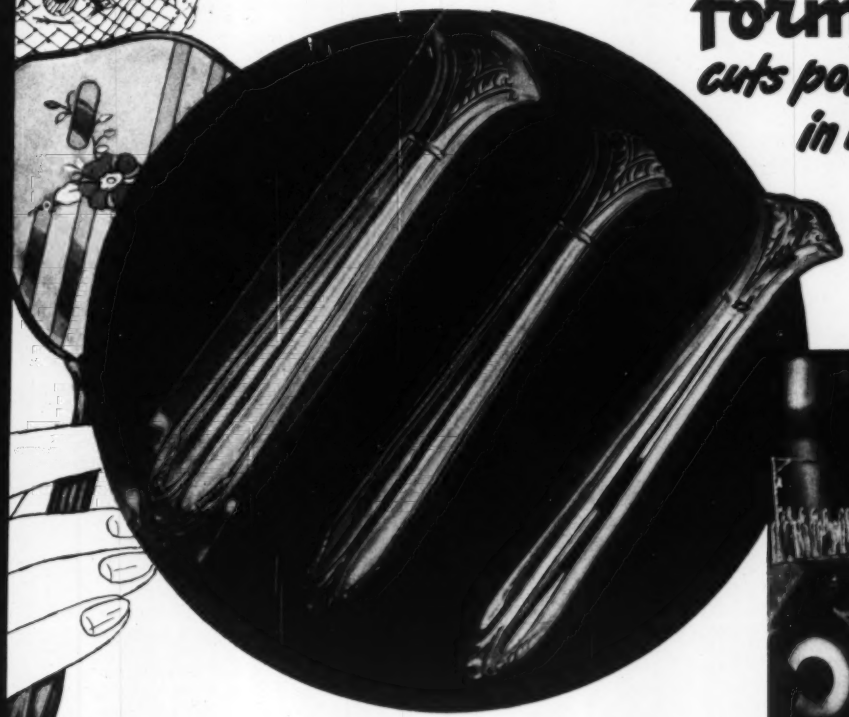
Contributed in the National Interest by

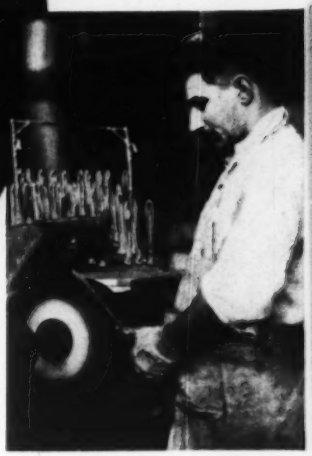
ALLEGHENY LUDLUM STEEL CORPORATION

Henry W. Oliver Building - Pittsburgh 22, Penna.

ANOTHER CUSTOMER CONVINCED:

Formbrite cuts polishing time in half





Mirror handle sections are formed on a 400-pound drop hammer from blanks measuring 1⅝" x 8" x .032". Trimmed and soldered, the completed Formbrite handle requires only a light "color buffing" operation—accomplished in half the time previously required for ordinary drawing brass. Handle is soldered to etched mirror back and lacquered to retain its lustrous finish.

ASTORLOID Manufacturing Co., Inc., Bronx, New York, makers of dresser sets and cosmetic containers, asked us point blank: "Just what *is* Formbrite*... and what will it do for us?" We explained that Formbrite is specially processed forming brass with such an exceptionally fine grain that buffing time is substantially reduced. It is stronger, "springier" and has a harder, more scratch-resistant surface than ordinary brass, yet is so ductile that it can be readily formed or drawn. Besides, it doesn't cost any more.

Astorloid's production engineers made a trial run of Formbrite in red brass alloy in their own press and polishing rooms and were amazed at the sharpness of the die impression ... and at the bright lustrous finish which was obtained by a simple "color buffing" operation in half the time previously required.

Millions of pounds of Formbrite sheet, strip, rod and wire have been produced and satisfactorily fabricated into a wide range of products. We'd like to tell you more about the time and money-saving possibilities of this fine-grain metal ... and send you a sample to try on your own polishing wheels. Address The American Brass Company, General Offices, Waterbury 20, Connecticut.

*Reg. U. S. Pat. Off.

Formbrite Drawing Brass is an

ANACONDA

PRODUCT

made by THE AMERICAN BRASS COMPANY

SOMEBODY pays for the scrap!

These screw machine parts, illustrated full size, are typical of the gas conversion appliances produced by Anderson & Forrester. Note the wide range of secondary machining operations necessary, such as slotting, milling and cross drilling. Some orifices require a No. 80 drill (.0135").

...and by scrap we don't mean the rod ends and chips incidental to screw machine operations—we mean the machined parts that, for one reason or another, wind up in the scrap bins instead of the shipping department. No one can speak with more authority than Anderson & Forrester, Denver, Colorado, manufacturers of gas jets, orifice caps, plugs, pilots and similar natural gas conversion appliances:

"We've been in business 25 years. We make hundreds of different screw machine products—millions of units a year—using over a million pounds of Anaconda Free Cutting Rods. We like these rods because we've always found them to be uniform in temper, dimension, machinability and over-all quality. Recently it was necessary to substitute some rods of a different make. Our operators spotted the difference immediately, complaining of 'hard temper,' excessive scrap and tool wear.

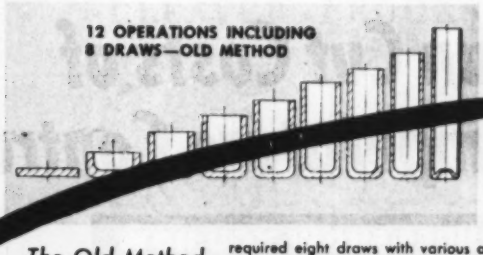
"We don't like to pay for scrap, nor can we pass along the cost to our customers. We depend on Anaconda Rods for the uniformity that gives us maximum tool life and permits us to duplicate standing records of speeds and feeds for long, uninterrupted production runs."

There are 46 Anaconda Copper and Copper Alloy Rods in a wide variety of commercial sizes and shapes suitable for screw machine use. Nineteen are free cutting alloys. Write for a copy of Publications B-14 and B-3, addressing The American Brass Company, General Offices, Waterbury 20, Connecticut.

ANACONDA

FREE CUTTING RODS

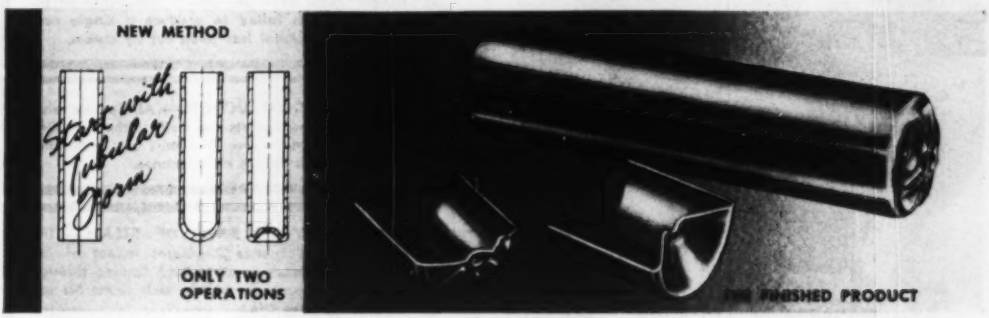
for top screw machine production



Draw the line on the OLD PRACTICE

The Old Method required eight draws with various annealing and cleaning operations between to produce the part shown below.

Now You Can do it a Simpler, Faster Way



By the New Method all the draws are eliminated since the part is a tubular form to start with (it begins as a section of Wolverine seamless copper tube). The ends are closed by the Wolverine Spun End Process*, then formed on a punch press.

THE SAVINGS in TIME and MONEY

- *Fewer operations are involved*
- *Machine time is reduced*
- *Tool cost is lowered*
- *Resulting scrap is negligible*

These are factors of real concern today.

MAKING A TUBULAR PRODUCT?

Would you like to make it faster? At less cost? With a minimum of scrap? In an improved design that will function more efficiently?

CONSULT OUR CUSTOMER ENGINEERING SERVICE

Our extensive experience may supply the answer to some or all of these questions.

**A patented process No. 22465*

WOLVERINE TUBE DIVISION
Calumet & Hecla Consolidated Copper Co.
INCORPORATED
Manufacturers of seamless, nonferrous tubing
1437 CENTRAL AVENUE · DETROIT 9, MICHIGAN

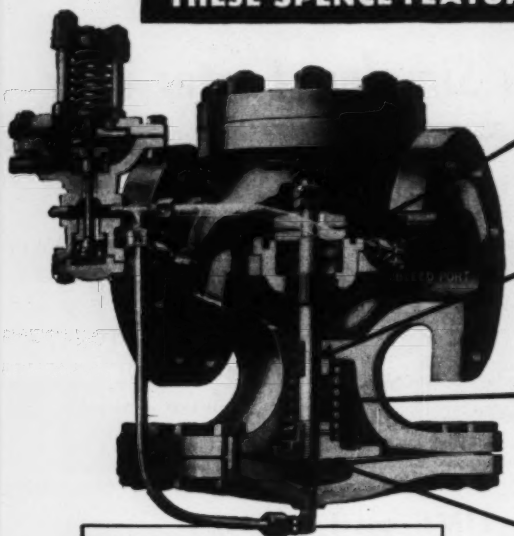
PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA
Sales Offices in Principal Cities

Export Department, 13 E. 40th St., New York 16, N. Y.

HERE'S PROOF

You Can Cut Costs of Pressure and Temperature Control

THESE SPENCE FEATURES SHOW YOU HOW



SPENCE Type ED Pressure Regulator

SECO METAL SEATS AND DISCS — Durable SECO Metal resists wiredrawing. *More than twenty years of experience* in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

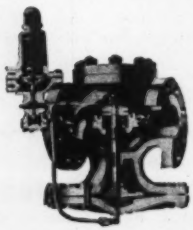
SPRING OUT OF PATH OF STEAM — The spring in the Spence Regulator is out of the path of the steam or other fluid flowing through the valve. It operates at low unit stress for exceptionally long life.

LARGE BALANCED DIAPHRAGM—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.

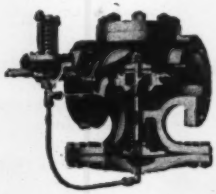
YOU BENEFIT by these and many other Spence features that assure *accurate, dependable* regulation year after year. That means *less down-time, less time and money wasted on replacement of parts.*

Spence Pressure and Temperature Regulators are built in sizes from *¼" to 12"* for service with *air, steam, water, oil or gas.* Only minor adjustments are needed to switch any Spence Regulator from one service to another.

Type ET150 Temperature Regulator—Tops in performance for both storage and instantaneous heaters.



Type EN Differential Regulator—Accurately controls differential between fluid delivered by regulator and some other source of pressure connected to the pilot spring chamber.



Type EQ Back Pressure Regulator — Completely packless, pilot operated for accurate control of the initial pressure.

These Companies Have Profited with SPENCE!

The Springs Cotton Mills
Ford Motor Company
Pennsylvania Power & Light Company
Jones & Laughlin Steel Corporation
National Tube Company
The Atlantic Refining Company
Great Lakes Steel Corporation
Todd Shipyards Corporation
Land O'Lakes Creameries, Inc.
General Electric Company
R. J. Reynolds Tobacco Company
Ohio Edison Company

and thousands of others

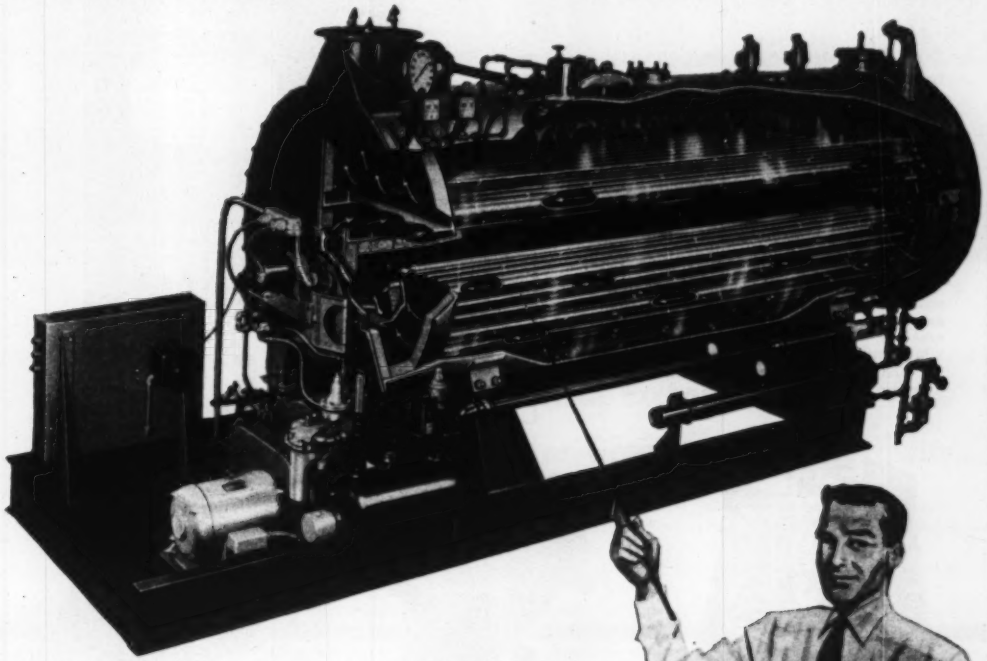
SPENCE ENGINEERING COMPANY INC.
WALDEN, NEW YORK

Spence

CLEAVER-BROOKS STEAM BOILER

Four-Pass Construction

MEANS HIGH HEAT TRANSFER — GUARANTEED 80% EFFICIENCY



The basic reason for the high thermal efficiency and low fuel costs of Cleaver-Brooks Steam Boilers is graphically shown above.

Note the original and exclusive Cleaver-Brooks four pass construction of the boiler. The four complete passes of combustion gases traveling through the entire tube length of the boiler proper enables the boiler to absorb the greatest practicable amount of heat from the fuel burned.

All Cleaver-Brooks boilers are of the four pass design and the maximum useable heat is absorbed in these four passes before the combustion gases leave the boiler.

Cleaver-Brooks steam boilers offer many advantages . . . quick, effortless response to fluctuating steam demands — minimum manpower needed for operation and maintenance — clean — space saving — low cost installation — dependable performance — burns the fuel most available and most economical in your area — oil or gas.

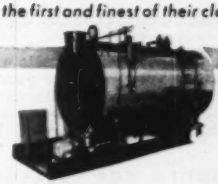
Remember the name Cleaver-Brooks, it stands for the first and finest in steam boilers. Standard models available in sizes from 15 to 500 HP, 15 to 250 psi, oil, gas, combination oil and gas firing.

CLEAVER-BROOKS COMPANY
Dept. B, 316 E. Keefe Ave., Milwaukee 12, Wis.

Builders of Equipment for the Generation and Utilization of Heat • Steam Boilers • Oil and Bitumen Tank-Car Heaters • Distillation Equipment • Oil and Gas-Fired Conversion Burners

Write for your copy of the latest illustrated Cleaver-Brooks Boiler Catalog. It tells and shows why Cleaver-Brooks Boilers will save you money.

Cleaver-Brooks
STEAM BOILERS
the first and finest of their class

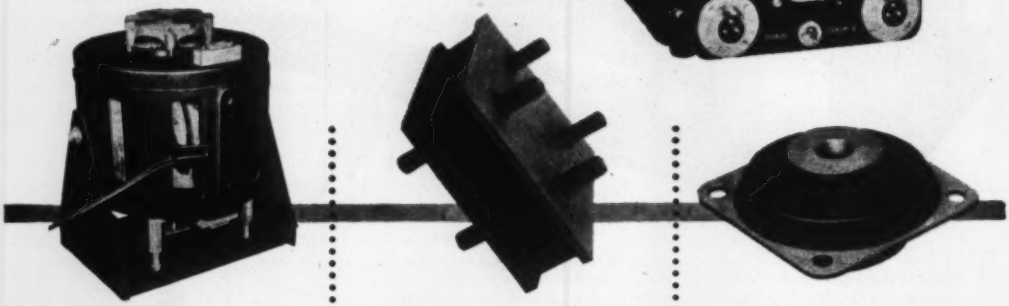


How MB can help you

MEET MILITARY SPECIFICATIONS ON VIBRATION

DOES YOUR MILITARY PRODUCTION require vibration *testing?* Shock *absorption*—vibration *isolation?* Representative of MB's specialized vibration engineering, these products show that, from a single source, you can get the equipment and information you need to meet your requirements. For example:

1. MEASUREMENT of vibration with MB vibration pickup and meter supplies data for study of disturbing frequencies and for design adjustments. The electrically damped and highly sensitive pickup is convertible for horizontal or vertical operation. Meter gives you accelerations, velocities or displacements of the vibrations directly. Made for each other, the two are the "eyes" for any vibration testing program.



2. SHAKE TESTING TO MIL-E-5272 and 41065-B is easily accomplished with MB Vibration Exciters. Model S-3 shown delivers 200-lb force. Others available with 10-lbs to 2500-lbs force ratings—all easily, quickly and accurately controlled for force and frequency.

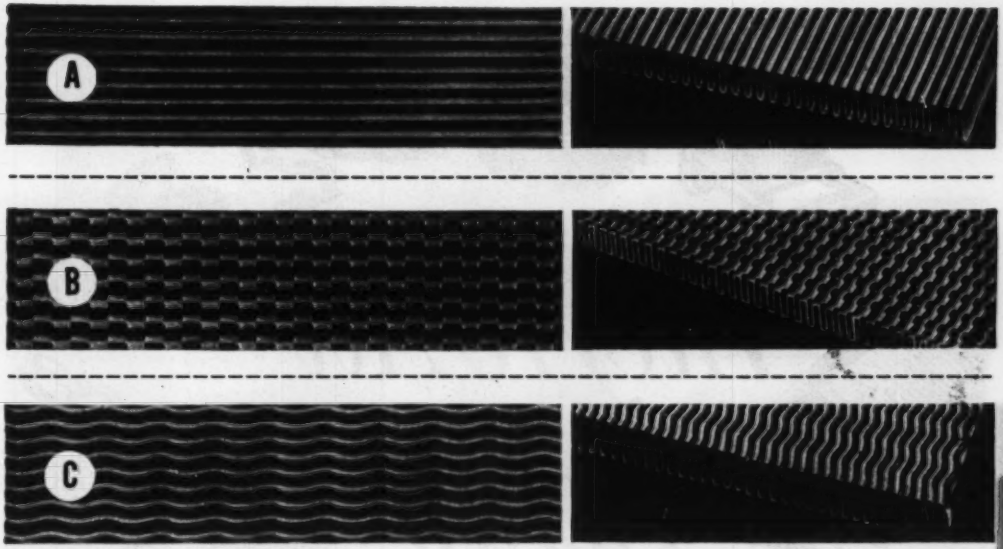
3. ISOMODE* SHOCK MOUNTS have been developed for supporting and protecting aircraft engines from damage while transported in crates or "cans." High load capacity combined with high deflection capacity provides good absorption of shock. **Reg. U.S. Pat. Off.*

4. MIL-I-5432 (AN-I-16a) can be met with the Type 17 ISOMODE Mount. This unit available for loads from 0.5 to 100 pounds, and controls all modes of vibration with equal efficiency because of equal spring rate in all directions.

Remember, if you need help with a vibration problem, you can save yourself time and work by contacting MB's vibration specialists. For details on any of the above products, address your inquiry to Dept. N4.

THE MB MANUFACTURING COMPANY, Inc.
1060 State St., New Haven 11, Conn.

PRODUCTS FOR MEASUREMENT . . . REPRODUCTION . . . AND CONTROL OF VIBRATION



Three of the many types of fin section available.

TRANE Brazed Aluminum Heat Exchangers Offer Wide Choice of Heat Transfer Surfaces for Greater Design Flexibility

With Trane Brazed Aluminum Heat Exchangers, you choose from a great variety of surfaces in solving exactly your heat transfer problems. They may be straight and continuous (A). They may be serrated (B). Or they can be of herringbone design (C). With these basic designs, exactly the right surface can be selected to provide the correct ratio of heat transfer to pressure drop characteristics.

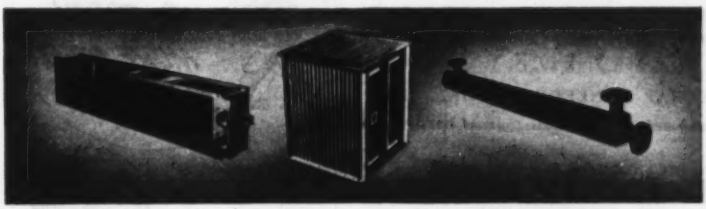
Many further variations of these general types are practical. The height and the thickness of the fin can be varied. So can the number of fins per inch. In fact, fins with entirely different patterns, heights and number of corrugations per inch can be used side-by-side to handle different fluids in the same exchanger.

Thanks to this great flexibility you can provide just the heat transfer, just the pressure drop volume, velocity number and direction of passes you want with Trane Brazed Aluminum Heat Exchangers.

Design flexibility is but one of the many advantages of Trane Brazed Aluminum Heat Exchangers. Compared to conventional exchangers, they produce more heat transfer efficiency in ¼ the space with ⅕ the weight at approximately ½ the cost.

These all-aluminum heat exchangers are rugged, too. They take test pressures up to 1,000 pounds per square inch and temperatures from −300° to 500° F.

Whether the job calls for high or low temperatures or pressures, one stream or many, Trane Brazed Aluminum Heat Exchangers can be the answer. Contact your Trane sales office or write direct.



Here are a few of the many varieties of Trane Brazed Aluminum Heat Exchangers which are now in actual service: 1) A cross flow unit for liquid-to-gas exchange used for condensing purposes. 2) A cross flow gas-to-gas unit which is used for intercooling for aircraft engines. 3) A counter flow liquid-to-liquid exchanger for high pressure application.

TRANE

MANUFACTURING ENGINEERS OF HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

THE TRANE COMPANY, LA CROSSE, WIS.
Eastern Mfg. Division . . . Scranton, Pennsylvania
Trane Company of Canada, Ltd. . . . Toronto

OFFICES IN 80 U. S. AND 14 CANADIAN CITIES

They're all needed to keep steel production up

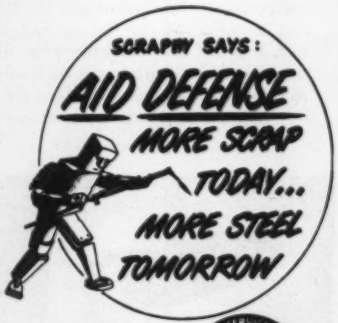
...TO AID DEFENSE

Every pound of unused iron and steel you have is needed to help steel mills and foundries keep production up to rising capacity.

Scrap inventories are alarmingly low. Mills that normally maintain inventories of several months, are now down to a day-to-day basis. Shutdowns are threatened.

One way we can maintain desired level of both military and civilian production is for you to *dig up* and *turn in* your iron and steel scrap now.

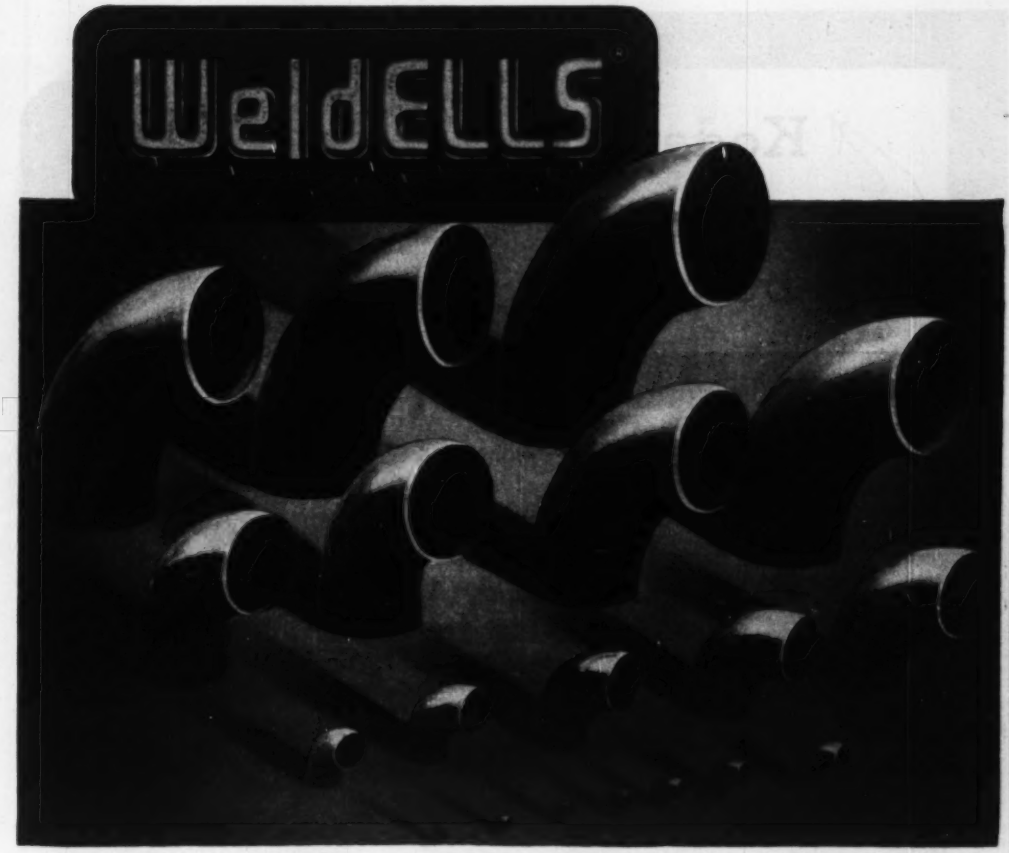
Get in touch with your local scrap dealer and write for the free booklet, "Top Management: Your Program for Emergency Scrap Recovery" to Advertising Council, 25 W. 45th St., New York 19, N. Y.



NON-FERROUS SCRAP IS NEEDED, TOO!

This advertisement is a contribution, in the national interest, by

MECHANICAL ENGINEERING



Just a Corner of the World's Largest Line

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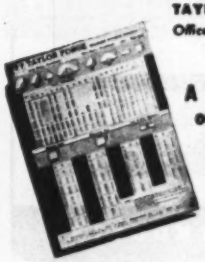

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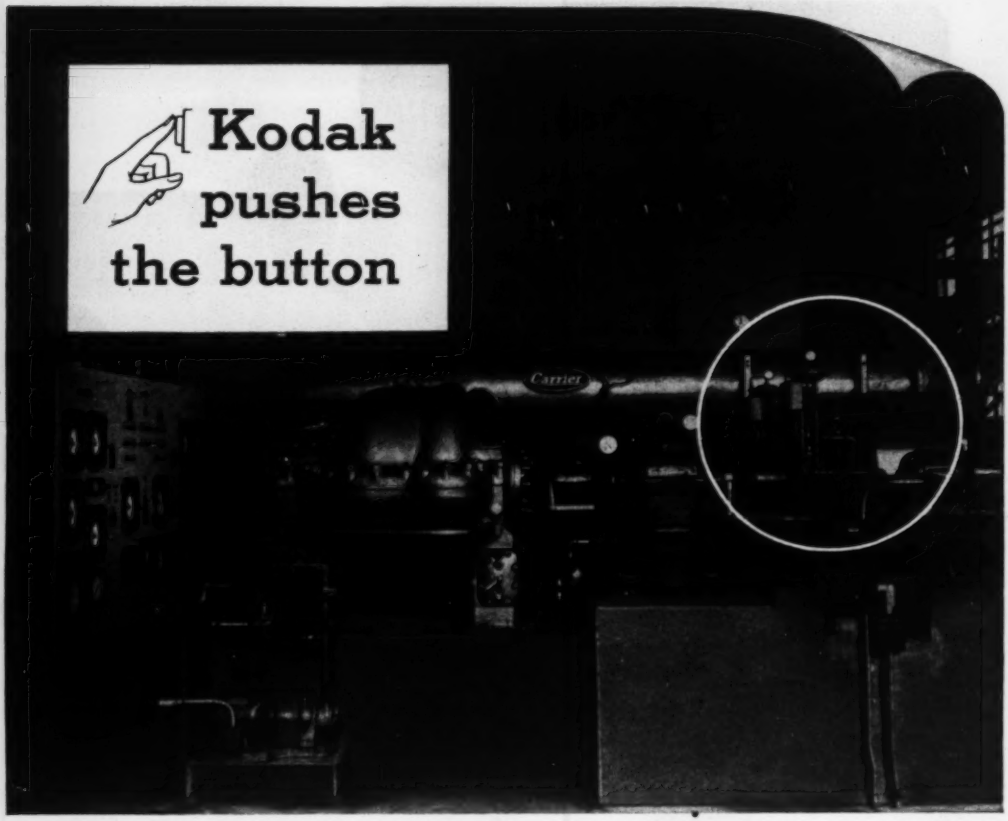

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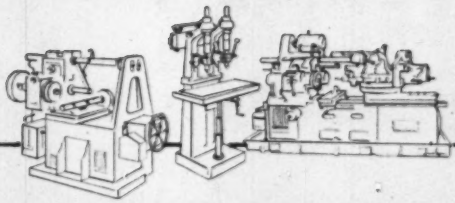

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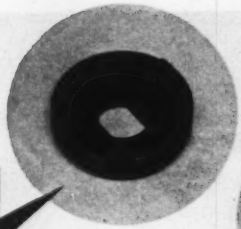

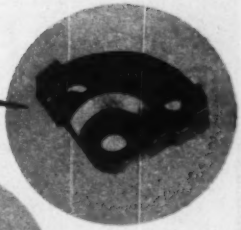

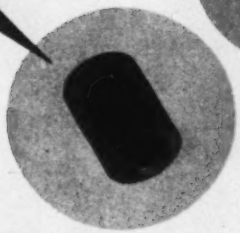

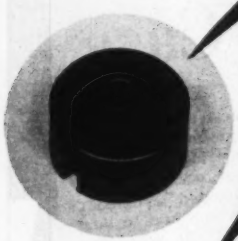

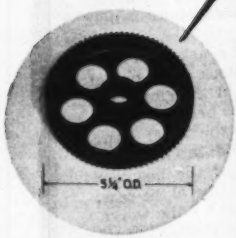

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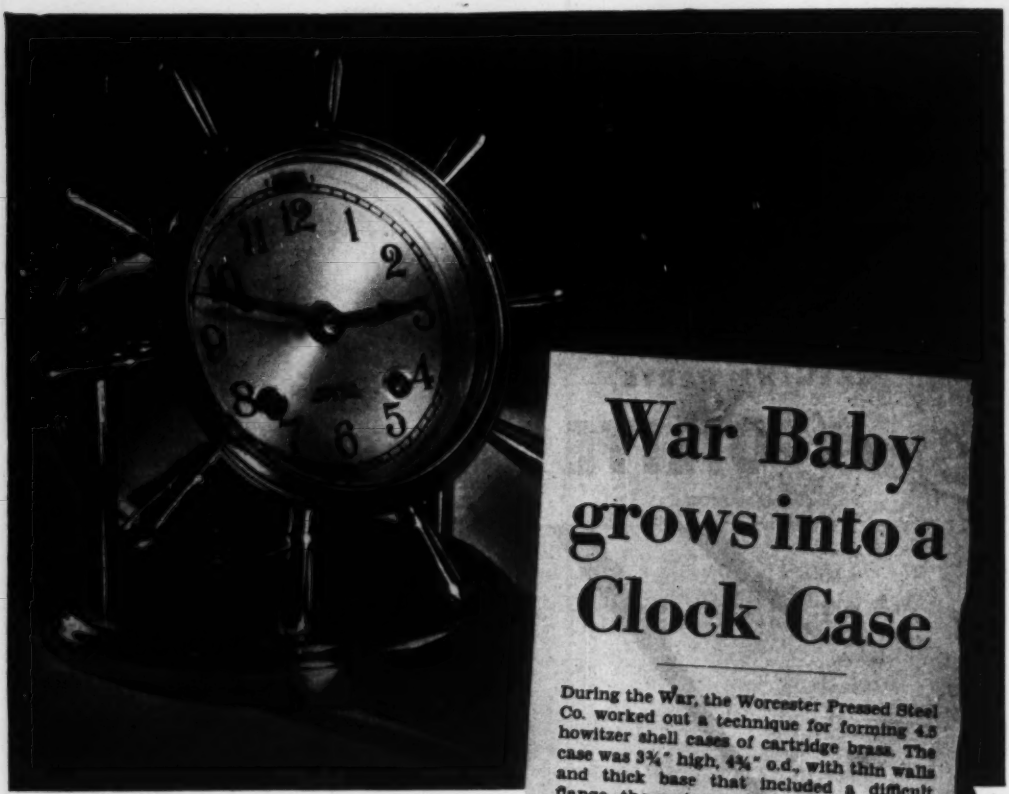

Chelsea Ship's Bell Clock, The Vanderbilt model, made by Chelsea Clock Co., Chelsea 50, Mass. Case drawn in one piece out of commercial brass by Worcester Pressed Steel Co., Worcester 6, Mass.

War Baby grows into a Clock Case

During the War, the Worcester Pressed Steel Co. worked out a technique for forming 4.5 howitzer shell cases of cartridge brass. The case was 3¾" high, 4¾" o.d., with thin walls and thick base that included a difficult flange, the material for which had to flow entirely from the base of the cup. The successful solution of the many problems required careful tool design, plus skilled control of each operation.

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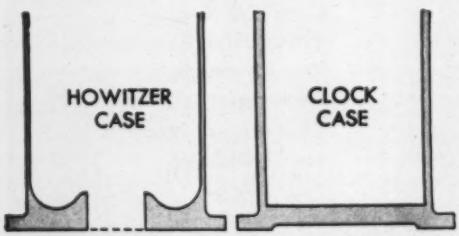

Cross sections showing similarities and differences between the howitzer case and the clock case.

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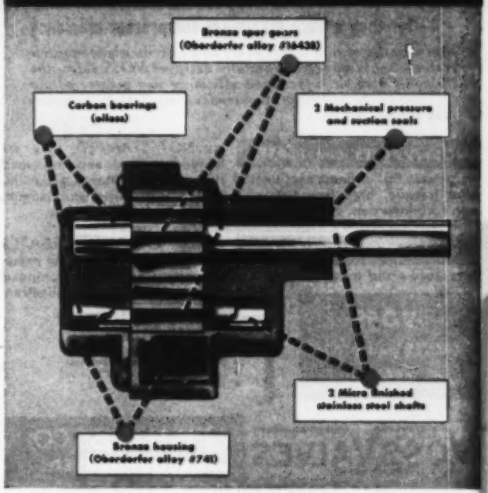
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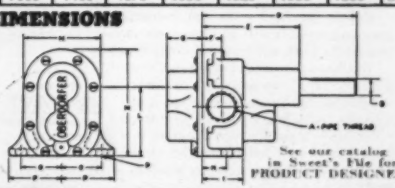

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3	½	5/8	4 11/16	3	11/32	1 1/4	3/4	1 1/4	2 5/8	4	2 3/4	1 1/16	1 1/8	13/32
4	½	5/8	5 3/16	3 3/16	11/16	1 1/4	7/8	1 3/16	2 5/8	4	2 3/4	1 3/16	1 1/8	13/32
7	3/4	5/8	5 3/16	3 3/16	3/4	1 1/4	7/8	1 3/16	3 3/4	5 1/4	3 3/4	1 3/8	2 1/8	13/32
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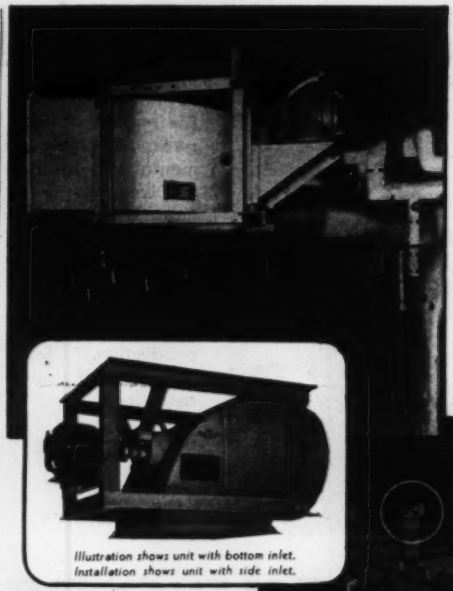

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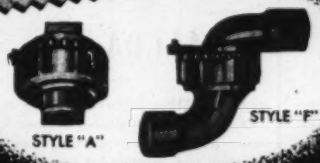

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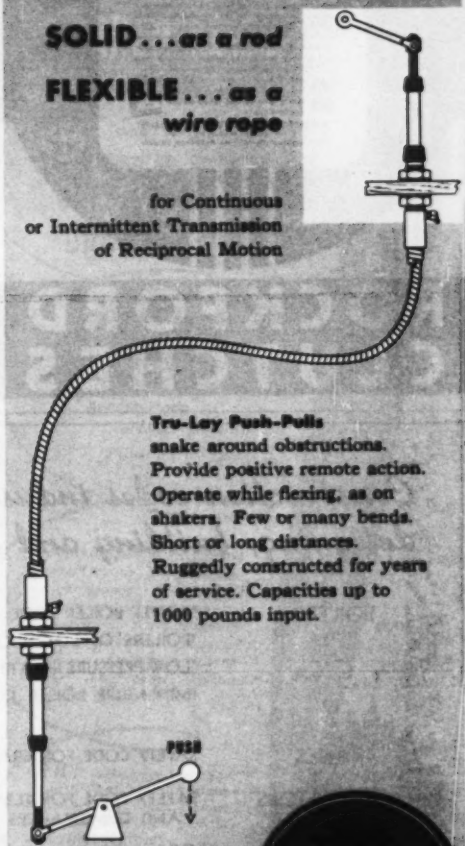

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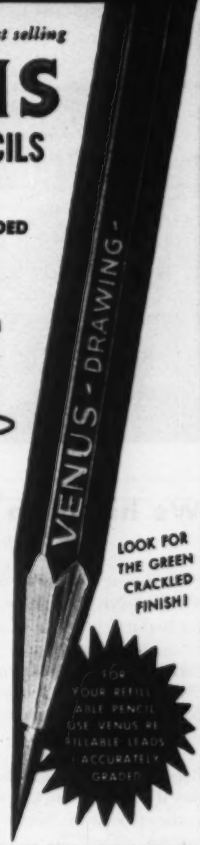

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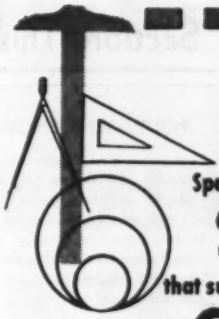

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"OPPORTUNITIES" Section This Month 139-147

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ENGINEERS—Expanding southern industry has openings for mechanical engineers for design and machinery development work; experienced electrical engineers and engineer experienced in structural steel and reinforced concrete design. Pulp or paper industry experience helpful but not essential. Please give in first letter full details of education, age, experience, qualifications, references, availability and salary desired. All details confidential. Address CA-3765, care of "Mechanical Engineering."

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Excellent opportunity. Top salary. Permanent position fo GRADUATE MECHANICAL ENGINEER, age 25 to 35. Newly organized dept., long established company with product essential in peace time as well as time of nat'l. emergency. Experience in equip. design desired but not essential. Company pension plan, hospitalization. Midwest location. State completely education, previous experience, salary desired. Address CA-3807, care of "Mechanical Engineering."

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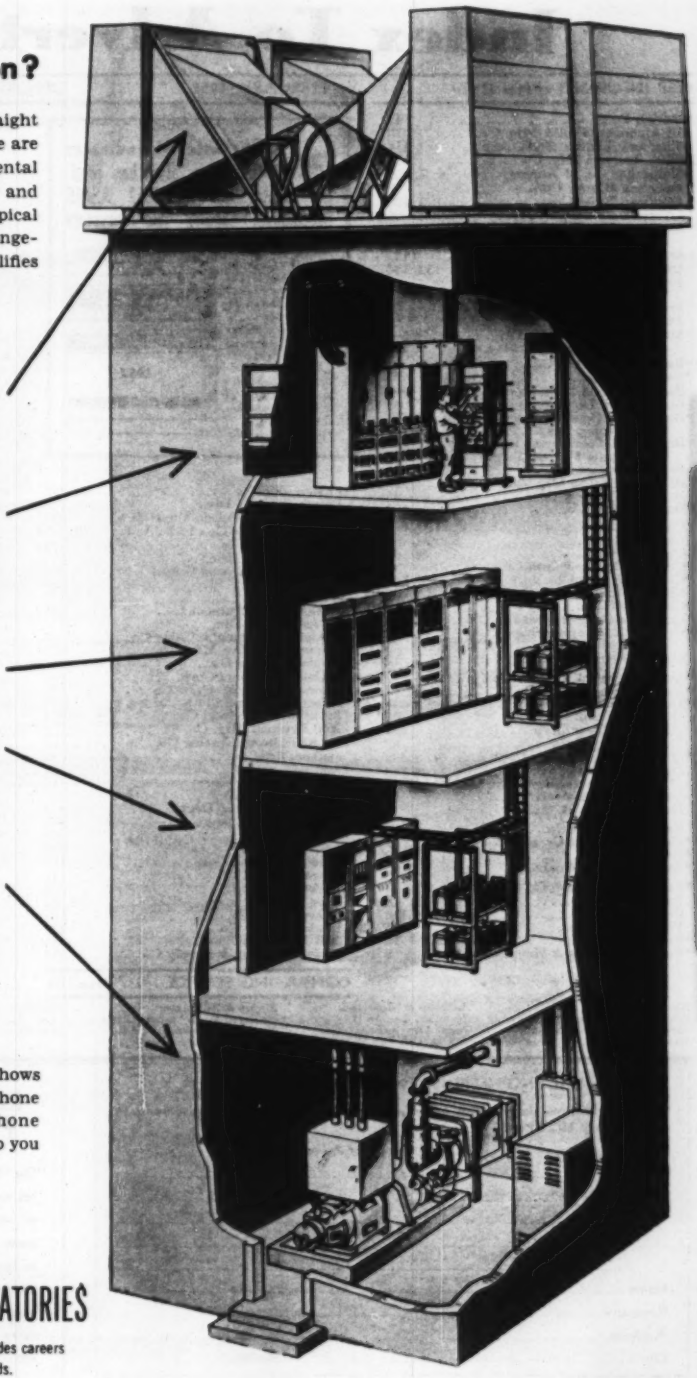
that his products . . . the service in them and the service behind them . . . will stand up under the most searching scrutiny of the high calibre engineers and executives comprising MECHANICAL ENGINEERING readership.

What's inside a *Radio-Relay* station?

Because microwaves travel in straight lines and the earth is round, there are 123 stations on the transcontinental television route between Boston and Los Angeles. This view of a typical unattended station shows the arrangement of the apparatus which amplifies the signal and sends it on.



ON THE ROOF are the lens antennas, each with its horn tapering into a waveguide which leads down to equipment

ON THE TOP FLOOR, where the signal is amplified, changed to a different carrier-channel and sent back to another antenna on the roof. Here are testing and switching facilities. Normally unattended, the station is visited periodically for maintenance.

ON THE THIRD FLOOR are the plate voltage power supplies for several score electron tubes.

ON THE SECOND FLOOR are filament power supplies. Storage batteries on both floors will operate the station in an emergency for several hours, but

ON THE GROUND FLOOR is an engine-driven generator which starts on anything more than a brief power failure.

Anything that happens—even an opened door — is reported to the nearest attended station instantly.

Coast-to-coast *Radio-Relay* shows again how scientists at Bell Telephone Laboratories help your telephone service to grow steadily in value to you and to the nation.

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Improving telephone service for America provides careers for creative men in scientific and technical fields.

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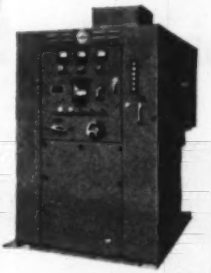
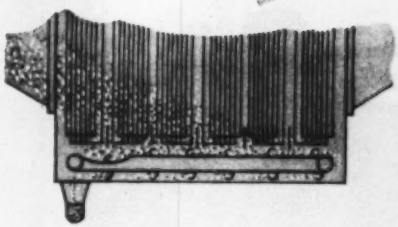
1



This Koppers "packaged" mechanical or vacuum tube power pack is not restricted to an area near the precipitator. It can easily be installed in any convenient place in the plant. Result: Compact designs! More flexibility!

2



This Koppers exclusive—the bottom drag scraper—provides continuous dust removal. Cumbersome hoppers are eliminated and dust handling is simplified. Result: Lower operating costs! Less space requirement!

Here are two ways Koppers engineers simplify precipitator operation for you!

PERFORMANCE GUARANTEED!

Koppers engineers protect your investment in an electrostatic precipitator by guaranteeing both the recovery or gas-cleaning *efficiency* and the *residual content* left in the gas after cleaning. Koppers-Elex electrostatic precipitators are designed, engineered, fabricated, erected and guaranteed *under one contract* by Koppers Company, Inc.

IN ADDITION to high efficiency, Koppers concentrates on the practical aspects of electrostatic precipitator design. Shown above are just two of the many practical features which simplify operation.

Besides these compact power packs and the continuous dust removal features, Koppers-Elex electrostatic precipitators may be of the multiple-chamber type. This means one chamber may be shut down for inspection or maintenance without stopping the gas-cleaning action. The dirty gas is simply diverted through other chambers where cleaning continues.

Because rapping is *sectionalized*, re-entrainment is minimized. And because successive collection fields can be separately *energized*, maximum voltage can be applied to each field—with higher gas-cleaning efficiency resulting. Pressure drops are negligible.

IF YOU HAVE A GAS-CLEANING PROBLEM, write and outline the details for us to review. There is no obligation. Just address your letter to: KOPPERS COMPANY, INC., *Precipitator Dept.*, 222 Scott Street, Baltimore 3, Maryland.

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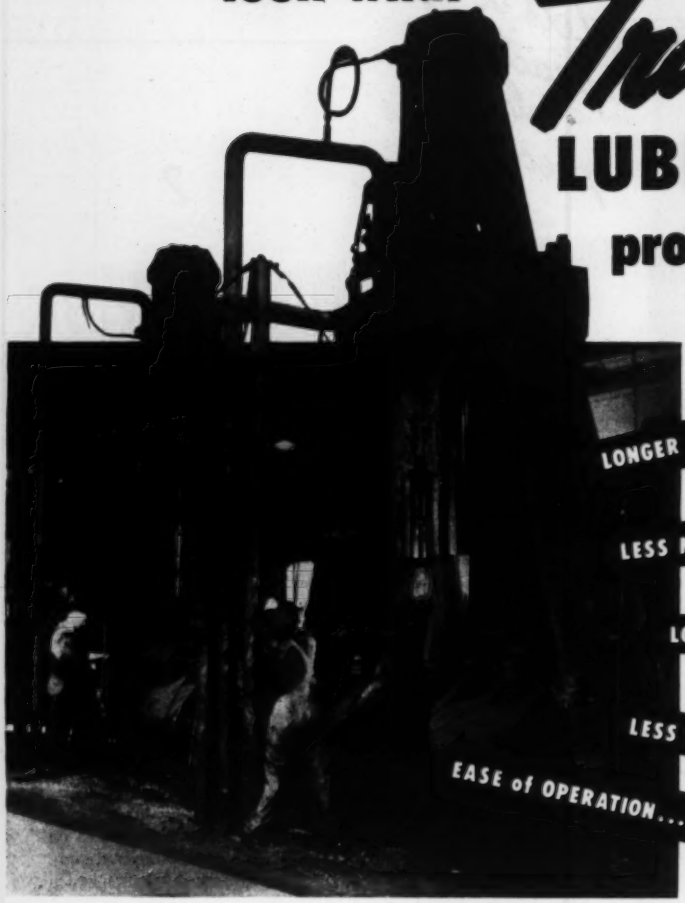

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Here—as on all types of machines—Trabon assures lubrication that is vital to uninterrupted production . . . eliminating down time for repairs and maintenance.

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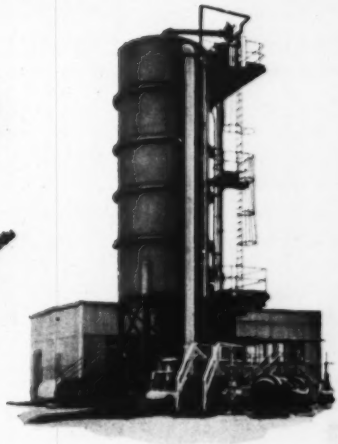

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PREVENTS TUBERCULATION
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A chemical company in California installed a Permutit 5,000 gpm Vacuum Deaerator just over 2 years ago. Now here's what they have to say about it after exhaustive checking and comparison.

"The benefits occurring from water deaeration are difficult to calculate in their entirety, since so many of the advantages in small items such as clean water lines, better operation of valves, less frequent water line replacement and better water flow cannot be easily assessed. However, the major corrosion costs in this plant . . . have been determined and compared with the cost of deaeration . . ."

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Makes pipe threading a pipe with help of TIMKEN® bearings

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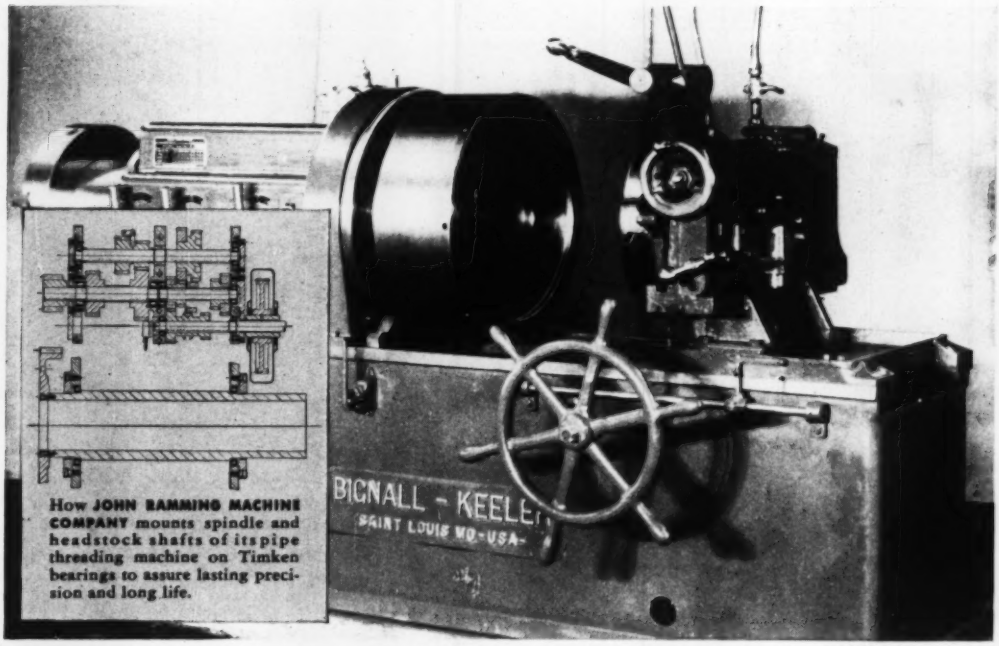
Timken tapered roller bearings on the spindle take radial and thrust loads in any combination—assure spindle rigidity. In the gear train, Timken bearings hold shafts in proper alignment—help make gears mesh smoothly with less wear. A smooth flow of power is assured over a wide range of speeds and feeds.

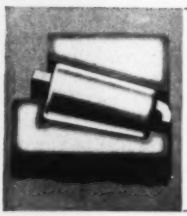
The true rolling motion and incredibly smooth finish of Timken bearings practically eliminate friction. Wear is minimized and precision is maintained throughout the machine's moving parts.

No other bearing can give you all the advantages you get with Timken tapered roller bearings. Make sure you have them in the machines you buy or build. Look for the trademark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



How JOHN RAMMING MACHINE COMPANY mounts spindle and headstock shafts of its pipe threading machine on Timken bearings to assure lasting precision and long life.



GREATER LOAD AREA

Because the load is carried on the *line* of contact between rollers and races, Timken bearings carry greater loads, hold shafts in line, wear longer.

The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

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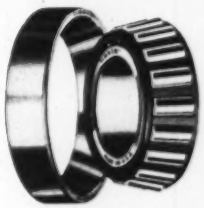

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